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PRACTICAL DIETETICS ❧ ❧ ❧

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PRACTICAL
DIETETICS

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TO THE MEMORY OF MY FATHER,
Nathan Gregory Benedict (Jr.)
THIS VOLUME IS AFFECTIONATELY
DEDICATED.

PREFACE.

It has been the endeavor of the writer to present, as briefly as possible, a fairly comprehensive discussion of that important branch of therapeutics—Dietetics. Dietetics must rest, even more firmly than medicinal therapeutics, upon the principles of physiology. Works on dietetics may appropriately follow the lines of the Dispensatory—cook books—of treatises on Materia Medica or of the therapeutic portions of text books on the Practice of Medicine. Considering the large number of excellent publications of the first two kinds, it has been thought that a work on Dietetics could best deserve the qualification of Practical by assuming that the reader has at his command technical culinary skill, by omitting minutiæ which are largely acquired by empiricism and by endeavoring to present mainly the underlying principles and facts upon which the adequate and properly guarded nourishment of the body depends, whether in health or in disease.

A L Benedict.

Buffalo, August 1, 1904.

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CHAPTER I.

THE CHEMIC BASIS OF DIETETICS.

Dietetics is essentially the science and art of supplying to the body substances needed for its growth and the repair of waste, as well as those whose oxidation within the body may furnish energy, including heat, and also such substances as are necessary, either physically or chemically, to the proper performance of the bodily functions. Indeed, dietetics includes within its scope everything needed to support life within the body, except oxygen, for whose assimilation a special apparatus is provided. Dietetics, to be more than merely empiric, must rest upon a study of physiologic chemistry and physiologic physics. We must know of what the body consists, to realize what it needs for growth and repair; we must know how it converts raw material into part of itself and how it consumes those substances which serve as fuel for its complicated machinery, or we cannot intelligently supply its needs at proper times and in proper amounts and kinds, especially when some part of the nutritive apparatus is out of order. Those substances which neither form parts of the body nor are available as fuel cannot be rationally employed unless we comprehend the various lubricating, convective, protective or other auxiliary functions which each subserves. And, finally, our science and theory must be modified and perfected by a wise empiricism.

ELEMENTAL ANALYSIS.

An elemental analysis of the body is of especial value negatively, by excluding from consideration the majority of chemic elements, as unnecessary or, at most, as of use only as drugs in morbid conditions. Not to mention the obvious introduction of drugs or poisons, the analysis of the human body or of the higher mammalian bodies differs somewhat according to local circumstances, even in regard to the number of elements found. Traces of copper, bismuth, etc., may be found in certain mining regions, bromin is present in denizens of the sea-shore, lithium in the vicinity of certain mineral springs and even arsenic is found in certain regions where its use is a hereditary habit and there seems to have been established a tolerance at variance with the teachings of toxicology. Probably most metals are present at one time or another, without producing morbid conditions. But the following fifteen elements are universally present while no others are known to be essential:

Elements always found as essential constituents of protoplasm; H, (metallic); C, O, N, (non-metallic).

Elements found as essential parts of certain forms of protoplasm; S, P, (non-metallic).

Other metallic elements necessary, Fe, Ca, Mg, Na, K.

Other non-metals necessary, Cl, Si, I, F.

The first four, commonly known as the CHON group, compose about 97 per cent of the whole body. H was formerly considered a non-metal, but there is no more reason for excluding it from the metals because of its gaseous state at ordinary temperatures than for excluding mercury because the latter is usually a liquid.

H, C, and N are absolutely inert and worthless unless introduced in inorganic or organic combination. Oxygen used for the purpose of oxidation, or combustion of organic fuel-foods, is inspired in the elemental state from the air. Oxygen as a constituent of protoplasm, of other organic foods or of inorganic auxiliaries, is mainly taken in in the appropriate organic or inorganic combination. In proportion to their chemic affinity and the presence of substances with which combination is possible, all of the other constituent elements of the body may be utilized if ingested in the elemental state. Except, however, for the loose combination of organic and inorganic radicles, organic constituents of the body are ingested as such and the same is true of inorganic constituents, although, in these respective classes, minor changes may occur.

S and P, ingested as elements, are essentially foreign substances, differing materially in their functions from the same elements introduced as sulphates and phosphates respectively, and again from sulphur- and phosphorus-containing proteids.

Ca, Mg, Na, K, Cl, Si and F, supposing the last to be obtainable in elemental form, would immediately enter into combination with protoplasm or other nitrogenous matter, or would form inorganic salts on account of mutual inorganic affinities. Excepting the primary corrosive action, they would then act precisely as if introduced in the combination immediately formed after ingestion. Iron and iodin seem to be able to unite, step by step, to produce the modified organic compounds, hemoglobin and iodothyrin, respectively, by which they are normally represented in the body. But, in all these elemental introductions into the body, the primary medicinal or toxic effect must be considered and only a small part of the element thus introduced is finally available, the remainder being eliminated without ever having become genuinely a part of the body.

ELEMENTAL COMPOSITION OF HUMAN BODY.
(AFTER MOSS.)

	Proportion.	Pounds.
Oxygen	.62432=	92.4
Hydrogen	.09864=	14.6
Carbon	.21351=	31.6
Nitrogen	.03108=	4.6
Phosphorus	.00945=	1.4

Calcium	.01891=	2.8
Sulphur	.00162=	.24
Chlorin	.00081=	.12
Sodium	.00081=	.12
Iron	.00013=	.02
Potassium	.00229=	.34
Magnesium	.00027=	.04
Fluorin	.00013=	.02
Silicon		Trace
Iodin		Trace
Total	1.00197=	148.30

The union of elements to form inorganic compounds and the loose union of element or inorganic compound to organic compound is, in no sense, a function of animal cells, but occurs solely as a matter of chemic affinity of substances accidentally placed in juxtaposition at the body temperature. Nor has any animal cell, unless of a type closely approaching the vegetable, the power of transforming inorganic to organic substances. Animal physiology does include the power to transform organic substances of one kind into organic substances of a far different kind, and to break down certain organic compounds into simpler organic combinations, or even into certain inorganic derivatives, but the building up of inorganic into organic compounds is a function of vegetable cells—or of animal cells closely analogous to the vegetable and far removed from the mammalian type—acting under the actinic influence of sunlight.

CHAPTER II.

PROXIMATE PRINCIPLES.

A better understanding of the needs of the body is obtained from a study of its proximate principles, that is of the compounds of elements as they actually occur in the body. In a general way, these are fairly well understood, but no analytic tables are quite complete and some substances are stated in percentages of the entire body, others with reference to the muscles as 100 per cent, etc. I have been unable to find, after several years' search, any definite and carefully prepared table of the proportions of the body composed by the skeleton, the muscles, the vascular system, etc. The accompanying diagram may be considered as approximately correct. The considerable variation in the proportion of fat and of muscles disturbs all the percentages. For example, 100 more squares might be added to represent the accumulation of fatty tissue by persons who do not consider themselves obese in a pathologic sense; each square would then represent only ½ per cent. Fatty tissue contains 82 per cent. of pure fat.

The proximate principles may be classified as follows:

- Organic
  - Nitrogeneous
    - Proteids
      - CHON Proteids
      - CHONSP Proteids
    - Albuminoids
  - CHO Compounds
    - Carbohydrates
      - Polysaccharids
      - Disaccharids
      - Monosaccharids
    - Fats and Oils
      - Oleate of glycerole
      - Palmitate "
      - Stearate "
- Organic Modified by Inorganic Combination
  - Hemoglobin
  - Lecithin
  - Iodothyrin
- Inorganic
  - Water
  - Salts
    - Calcium
    - Magnesium
    - Potasssium
    - Sodium
    - Ammonium
    - Chlorids
    - Sulphates
    - Phosphates (including acid and neutral H-salts
    - Uric, Hippuric and other radicals produced by catabolism or by fermentation

It is a difficult matter, both theoretically and analytically, to draw the line between substances that are proximate principles of the body and those that are in, but not of, the body. The contents of the alimentary canal, the urinary bladder, the respiratory passages, etc., are obviously not part of the body. Similarly, purely excrementitious products, like CO_2, urea found in the tissues, including the blood, but unquestionably on the way to the emunctories, should not be considered proximate principles in the strict sense, though it will be necessary to recognize the effect of various foods in producing or favoring the retention or elimination of the various waste products. Neither is it usually one distinct step from unassimilated food to body constituent and from the latter to final waste product.

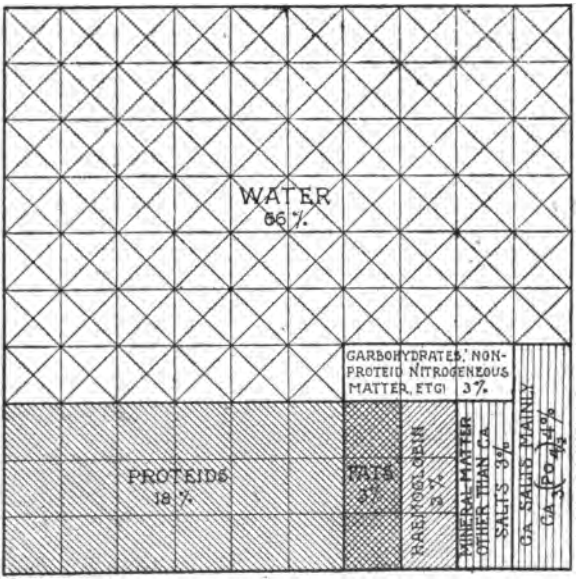


DIAGRAM SHOWING PROXIMATE PRINCIPLES.

EQUALIZATION OF ELIMINATION AND ABSORPTION. STORAGE OF NUTRIMENT.

Elimination is a fairly continuous process, especially that by the kidneys and the lungs. Elimination by the skin ordinarily amounts to little, as the water, salts and small amount of CO_2 can easily pass off through the kidneys and lungs. Probably some one will cite the instance of the little Roman boy who for some centuries has been supposed to have died from pent-in perspiration as the result of appearing as an angel in a suit of gilt paper pasted over his body. He may have died of heat stroke or as the result of some extraneous poison, or he may have had Bright's disease, but he certainly did not die as the result of retained perspiratory waste. Hepatic elimination, though of great value, is rather intermittent. Nutrition is, on the whole, much more intermittent than elimination, though not so much so as the cursory thought of meal times might suggest. The matter of intermittency of nutrition leads to a consideration of the storage processes of the body to minimize the inequality of supply at different times. It is often said that fat is the only kind of food that can be stored in the body, and it certainly seems that nature is over-prudent in burdening so many human beings with an ungraceful and uncomfortable load that can be of use only in case of accidental immurement or being cast away on a desert island. The absorption of fats occurs only for a few hours at the height of intestinal digestion when fat has been ingested. The emulsion of fat is plainly visible in the lacteals at this period only. There may be some "stoking" function performed by the receptaculum chyli and, possibly, some preparation of the fat in the mesenteric lymph nodes. With these exceptions, the fat is siphoned into the blood circulation from the thoracic duct rather intermittently and is deposited for future use—or future nuisance—in various parts of the body.

For carbohydrates, the liver performs a very perfect "stoking" function. All carbohydrates, as will be explained, are finally digested to some form of glucose and are absorbed by the capillaries of the portal system. The blood normally contains about 1:1000 of glucose. Any excess over this amount is converted by a hepatic ferment into glycogen or animal starch and is reconverted into glucose as needed. Thus, the liver acts as a tender to the engine of the body, for glucose is oxidized by means of a pancreatic ferment in the blood, and thus furnishes energy and heat. Not only the liver but all other glands and the muscles keep on hand small, local supplies of glycogen. Altogether, the body may store from 150 to 250 grams of glycogen, enough for eight or twelve hours' fuel. The storage power of the liver is limited to about 150 grams of glucose, absorbed as promptly as the glucose can pass through the intestinal wall. Any excess beyond this amount is eliminated by the kidneys. Hence we have the practical rule that, at one time, it is useless to administer more than 150 grams of readily absorbable carbohydrate, although larger amounts of starch may be given at one meal on account of the delay in digestion. As will be seen later, this limitation of the storage power of the liver corresponds very nearly to the need of the body at an average meal, on the customary basis of three meals daily.

It is possible that the liver has a storage function for proteids analogous to its glycogenic function, but this is not definitely known. Proteids are ultimately digested into peptones—some only as far as albumoses. Apparently these are changed back into lower grades of proteid, albumin and globulin, in passing through the intestinal wall. There does not seem to be any storage of proteids except in the plasma of the blood and the other fluids of the body, but the actual consumption of body proteid is normally small and in case of starvation of proteids the body, after drawing on the slight surplus in its juices, has no recourse except economy of waste of its tissues.

Non-proteid nitrogenous substances seem to be changed in the liver with immediate waste of the nitrogenous portion of the molecule and transformation of the remainder into glycogen, which then is dealt with precisely as if it had been derived from glucose.

Hemoglobin, etc., are very slowly wasted, and the matter of storage is not understood. Even when red blood cells are destroyed in the spleen, the hemoglobin is not all wasted, the bile pigments representing iron-free hemoglobin, and the iron being retained in the liver until it can recombine with nitrogenous organic matter. Except for traces in the bile and urine, there is scarcely any normal waste of iron except when the hair is cut or falls out.

Salts and water are absorbed from the alimentary canal or borrowed from one or another of the tissues and juices of the body, as needed, but there is no definite arrangement for storage. Under ordinary conditions, the body is wasteful of these inorganic constituents, but under stress it manages to retain a considerable part of what it would ordinarily excrete.

ORGANIC PROXIMATE PRINCIPLES—PROTEIDS.

Proteids are the basis of all living matter, the cell constituents, including proteid, other organic and inorganic proximate principles necessary to the cell, being known as protoplasm. Proteids vary somewhat in centesimal composition and the formula is not known, even empirically. However, we do know that all proteids contain 50—55 per cent of C; 15—18 per cent of N; about 7 per cent of H; and 20—23.5 per cent of O. Some authorities state that S is a constituent of all proteids, the range being 0.3—2 per cent. Others state that S, as is certainly the case with P, is present only in certain proteids.

Proteids are found in all tissues and juices of the body, though not in appreciable amount in all excretions and secretions. In general, the amount varies inversely to the proportion of water and inorganic salts. Most organs, freed from fat and inorganic principles, including water, contain about 50 per cent of proteid.

Proteids are classified into a number of groups, according to their reactions. The chief ones of the body are albumins and globulins, the latter coagulating under ferment action, from the blood, lymph, muscle plasma and milk. Albumins combined with acids, alkalies and other inorganic substances form other groups. Still other nitrogenous substances are on the border line between proteids and albuminoids, or are actually combinations of the two. During digestion, the various proteids and some of the albuminoids pass through progressive hydrolytic stages which tend to render them soluble or, if already soluble, more absorbable. These stages are somewhat arbitrarily divided into two groups, the earlier being called proteoses, the later peptones. But these substances immediately after absorption are changed back into lower forms of proteid or albuminoid, so that neither proteoses nor peptones are strictly proximate principles of the body.

Proteids form the principal solid ingredient of all non-calcareous and non-fatty animal organs. They are also abundant in eggs, milk, etc. In vegetables, proteids are usually present to a very slight degree, excepting in the seeds. Whether eaten green or after drying and grinding into meal or flour, and whether popularly designated as seeds, kernels, grains, nuts, etc., most vegetable seeds contain, after extraction of water, from 10—20 per cent of proteid. Water-free muscles and viscera of animals, including fish, shell fish, poultry, etc., contain approximately 50 per cent of proteid. These statements, however, are intended only to give a general conception of proteid value and must not be taken without qualification for any particular food-stuff. As has been stated, no animal cell, excepting those of certain lower forms which are closely analogous to vegetable life, has the power of manufacturing any organic substance. Animals of elaborately differentiated gastric development, with long intestinal canals, are able to sift out sufficient proteid from ordinary plants which contain only 1 or 2 per cent of proteid; such animals are designated *herbivorous.* Animals of simple gastric structure, comparatively weak digestive power and short intestinal length, are compelled to subsist on the flesh of other animals, eggs, milk, etc., and are designated *carniv-*

orous. Animals differing in no essential of alimentary anatomy from the carnivorous but having relatively longer intestines, more active secretion of amylolytic ferments and, on the whole, better digestive power, are able to subsist on seeds and other parts of vegetables which are comparatively tender and rich in nutriment. Certain rodents live almost entirely on these varieties of vegetable food; other animals, of which man and the hog are the most typic examples, subsist indiscriminately or jointly on animal and vegetable food, and are strictly termed *omnivorous.* Whether on account of noticeable differences in anatomy or not, is unknown, but certain human beings are relatively carnivorous like the cat and dog; others nearly vegetarian, like the squirrel; others truly omnivorous, like the hog. To a large degree, these differences, whether noted in man or in the domestic animals, are due to environment and habit or to idiosyncrasy, but, to a certain extent, they represent actual physiologic differences for which allowance must be made. As an example of change of natural habit necessitated by environment, may be mentioned the cows of some subarctic regions which live mainly on fish during the winter. Idiosyncrasy for foods is noted in most human beings. The most marked example which I have noticed in domestic animals was that of a cat which had to be shut up to prevent its picking and eating muskmelons, which are about as far removed as possible from its normal carnivorous diet, without any deprivation to compel such a change of food.

ALBUMINOID FOODS.

Albuminoids are a group of nitrogenous substances derived from proteids to subserve special purposes in the organism. These are better distinguished, at least analytically and in physical properties, than the various proteids.

Collagen, derived from bone, connective tissue and cartilage, becomes gelatin when hydrated by steaming or digestion with either HCl and pepsin or trypsin and alkali. Some authorities claim that the albuminoid of retiform tissue is distinct.

Elastin is derived from yellow elastic tissue, and gives to it its characteristic property.

Keratin is the "size" of external epithelium. A modified form occurs in neuroglia and the medullary sheathes of nerves.

Mucin is the characteristic secretion of internal epithelium, and, along with collagen, is found in cartilage.

Nuclein is the peculiar constituent of nuclei, and is relatively abundant in active mesoblastic cells, such as the white cells of the blood and lymph, because such cells have relatively much larger and functionally more active nuclei than epithelial cells, while the nuclei of fixed mesoblastic tissues have mainly atrophied.

Nucleo-albumin is, as its name implies, a combination of true proteid and albuminoid. It is the product of the cells of the biliary passages and certain others and, physically, it resembles mucin.

Of the albuminoids, keratin is practically indigestible, so that the ingestion of chicken skin must be regarded as the taking in of epithelial and fibrous structures of almost no value, while elastin is only digestible to a certain stage. Otherwise the digestion of albuminoids proceeds very much as that of proteids, but the result is only nitrogenous waste and a carbohydrate molecule which seems to become glycogen in the liver and, thenceforth, to act as if starch or sugar had originally been eaten. It is now believed that nuclein, at any rate, and perhaps the other digestible albuminoids, produce uric acid instead of urea as an end-product of catabolism. While the albuminoids undoubtedly act as energy-producers and thus save some waste of proteids, it is not even held that they can supply the need of substances of identical constitution in the body, these body albuminoids always being produced by partial decomposition of the proteids of the respective cells secreting mucin, keratin, nuclein, etc. Elastin and keratin are practically valueless as food. It is doubtful whether mucin, whether of endogenous origin or introduced from without, as in cartilage, is of any value as nutriment. Nuclein is found in thymus and other glandular organs containing notable amounts of lymphoid tissue, and in yeast. It is mainly employed as a drug. Gelatin is one of the principal ingredients of soups and broths and, indeed, almost the only possible nutritious constituent of extracts of meat made by boiling, except in the broad definition that would include water and salines as nutriments. It is also a basis for delicate and appetizing jellies.

CARBOHYDRATE FOODS.

The carbohydrates are produced in vegetable cells containing chlorophyl, under the actinic excitement of sunlight. The common ones contain a multiple of six atoms of carbon and all, by definition, contain two atoms of H to one of O. The end products of oxidation are CO_2 and H_2O, and as the mere separation of the molecule furnishes the latter, their combustion value is simply that of the contained carbon. They occur in three principal groups:

Polysaccharids are composed of molecules, each containing several or many times the radicle $C_6H_{10}O_5$. These include cellulose—the indigestible membranous portion of the vegetable cell—and starch and its derivatives. The latter are, in succession, soluble starch, erythrodextrins and achroodextrins.

Disaccharids have the general formula $C_{12}H_{22}O_{11}$. They are produced from the starch derivatives either by boiling with an acid or by a vegetable or animal ferment, termed generically a diastase. Cane sugar, occurring principally in the sugar cane, sugar beet and sugar maple; milk sugar; and maltose, produced outside the body chiefly in malting cereals, and within the body by the action of ptyalin and amylopsin, are the only disaccharids of practical importance in dietetics.

Monosaccharids are produced within the body by the further hydrolysis of the disaccharids by the ferment *invertin,* found in minute quantity in the gastric wall and, in much greater abundance, secreted by the intrinsic intestinal glands. The monosaccharids have the empiric formula $C_6H_{12}O_6$, and are due to the addition of a molecule of H_2O to a disaccharid radicle and the splitting or inversion of this union. According to their physical properties, especially their deviation of polarized light, they are distinguished as dextrose, levulose and galactose. Cane sugar is potentially dextrose, plus levulose; maltose is a double dextrose; lactose is dextrose, plus galactose. Honey and grapes and most other sweet fruits contain dextrose and levulose in various proportions, probably produced from starch by ferment in the process of ripening.

The disaccharids, introduced directly into the blood, or into the alimentary canal in amounts exceeding the digestive power of invertin, are excreted unused by the kidneys. Normally, all carbohydrates, whatever their ultimate source, are digested into dextrose or dextrose plus levulose or galactose. The excess beyond the immediate needs of the body, represented by approximately a 1:1000 solution in the blood plasma, is converted by a hepatic ferment into glycogen or animal starch, a polysaccharid. This is reconverted into dextrose—apparently the glycogen derivative is always dextrose, whether originally obtained from dextrose, levulose or galactose—as needed, and this is oxidized into CO_2 and H_2O in the blood, under the action of a ferment internally secreted by the islands of Langerhans of the pancreas. Some recent experimenters have disputed this ferment-oxidation, claiming that the oxidation can occur in an alkaline liquid like the blood without the intervention of a ferment Their own experiments, however, seem to show that the spontaneous oxidation at the body temperature of dextrose would be utterly inadequate. As already stated, the liver is not the only storage-bin of glycogen, smaller supplies which may be compared to scuttles of coal beside individual heaters, being kept in readiness for the local production of energy in all glands and muscles.

FATS AND OILS.

Fats and oils are salts of glycerole, a trivalent base whose hydrate is glycerin. The acid radicles concerned are chiefly those of oleic, palmitic and stearic acids, the compound with the first being liquid, that with the second a soft fat and that with the last a comparatively hard fat, at ordinary temperatures. Although a fat-splitting enzyme has recently been discovered in the stomach, its action is practically inconsiderable, the real digestion of fats being due to steapsin of the pancreatic juice, which splits them into base and acid, the former combining with water to produce glycerine, the latter uniting with the various alkaline and earthy metals which are present in the bile, pancreatic juice and intestinal secretion, as carbonates to form soaps, the hard Mg and Ca soaps passing out with the feces. A recombination of glycerin and the soluble soaps of K, Na and probably NH_4 appears to take place during absorption, the recombined fat being seized by polymorphous cells in the intestinal wall and carried into the lymph vessels. Fats and oils are slowly oxidized in the body, probably through the aid of a ferment. As they contain C, H and O, but less O proportionately than the carbohydrates, their heat potentiality is higher than that of carbohydrates. Fats and oils are sometimes termed *hydrocarbons,* but this term should be reserved for the mineral oils. The true fats and oils are directly derived from animal and vegetable sources. Within a few years, a commercial effort has been made to introduce mineral oils as substitutes for those of animal and vegetable origin. Mineral oils are absolutely indigestible and, therefore, non-nutritious. In impure form they possess antiseptic properties, but are liable to produce toxic symptoms. In pure form (Purpetrol) they are excellent emollients, protectives, ointment bases and lubricants, whether for external or internal use, but they lie absolutely outside the domain of dietetics.

CATABOLIC PRINCIPLES.

The various catabolic products of the body will not be considered systematically but will be alluded to as necessary, to guard against introducing them in the food or whenever their elimination may be modified by diet.

CHAPTER III.

INORGANIC PROXIMATE PRINCIPLES.

WATER.

Water is introduced into the body as a drink or an ingredient of solid foods, to the amount of about 2,000 c.c. daily. 500 c.c. additional is formed by double decomposition of organic compounds analogous to inorganic hydrates and by oxidation of the hydrogen of organic fuel-foods. The dryest foods rarely contain less than 10 per cent of water; fresh, juicy cooked meats contain about 60 per cent; ordinary dried meats, as prepared for the table, not much less than 30 per cent; juicy fruits, 90 to 95 per cent. Of the 2,500 c.c. daily at the disposal of the body, the proportionate elimination is approximately as follows:

Feces	4 per cent
Lungs	20 per cent
Skin, as insensible perspiration	30 per cent
Kidneys	46 per cent

These proportions are subject to marked change, the urine and perspiration being complementary. Whenever sensible perspiration occurs, nearly the entire amount lost in this way must be taken in addition to the regular daily supply.

SALTS.

The saline constituents of the body consist mainly of chlorids, sulphates and phosphates of Ca, Mg, K, and Na. But NH_4 and various organic waste products also occur as bases while carbonates regularly occur in the alkaline fluids of the intestinal tributaries and vegetable acids are introduced with food and other organic acids are formed in the bodily metabolism. The most abundant salt in the body is $Ca_3(PO_4)_2$ but it is mainly fixed as the mineral part of bones and teeth, forming 88.5 per cent of dental enamel, 57.6 per cent of bone. About 6.4 per cent of the entire body-weight is bone, so that a man of standard weight, 65 kilograms (about 145 pounds), would contain nearly 2.5 kilograms of $Ca_3(PO_4)_2$. Milk contains about 0.27 per cent of calcium phosphate and is the chief source of its supply not only to the infant but to the growing child. It is also found in eggs, meat, the various cereals, potatoes, apples, cherries and other fruits and vegetables. After the skeleton is fully developed, there is little need for this salt, as its elimination from the bones and teeth is very slight, while as age advances, the less Ca salts taken, the better, on account of the senile tendency to calcareous infiltration.

$CaCO_3$ is associated with $Ca_3(PO_4)_2$ in the proportion of about 1:7 and plays essentially the same role in the body. $Mg_3(PO_4)_2$ in the proportion of about 1:45 of $Ca_3(PO_4)_2$ and traces of $MgCO_3$ are also members of the group of fixed salines.

The other salines, which are soluble, except as mutual precipitation occurs, are mainly concerned in the function of osmosis. The chlorids, however, are the source of the secretion of free HCl by the stomach. Following the rapid extraction of acid radicle from the blood, there must be an excess of bases and these, in turn, are drawn upon during alkaline, enteropancreatic digestion. The daily excretion of NaCl amounts to about 10 or 15 Grams by the kidneys and from 3 to 10 Grams by the feces and sweat. Undoubtedly, less would be excreted if less were ingested but the excess seems to do no harm although the hypothesis has been advanced that cancer is more apt to develop in those who have eaten large amounts of salt.

Herbivorous animals require a considerable quantity of salt in addition to that contained in their fodder. The carnivores and man in a state of carnivorous savagery have no distinct appetite for salt. Although they secrete a highly acid gastric juice, the salt naturally present in meat and grains is, on the whole, enough to supply the needs of the body. Still, it does not appear that the wide-spread and distinct appetite for sodium chlorid is entirely a habit. It is well developed among vegetarian savages and, in fact, among most races above the stage of carnivorous savagery. Then, too, it may be assumed that secretory power is not so strong nor so economic among civilized peoples and thus a relatively high proteid diet requires more sodium chlorid than one in which proteids are low.

Si and F are mainly required in the formation of teeth and bone and are abundantly present in milk and cereals, which make up so much of the usual diet of childhood. Iodin has recently been added to our list of normal ingredients of the body, being the essential constituent of the organic secretion of the thyroid. An insufficient number of thyroid analyses render it probable that the amount of iodin is somewhat less in inhabitants of inland cities than of the sea-coast. The exact function of the iodin compound of the thyroid is not well understood, but the symptoms of deprivation and excessive secretion have been quite well formulated.

IRON.

Iron is a useful constituent of the body only as hemoglobin of the red blood cells and of the muscle plasma. It is eliminated only in traces in the bile and urine and in small amounts is deposited in the hair. Red cells, on the contrary, have a very definite mortality, being destroyed in the spleen. The liberated hemoglobin is broken up by the liver into useless and poisonous biliary pigment and into a simple form of iron. The latter is saved for future use but the exact process of its rehabilitation is not known. In any accidental hemorrhage within the body, almost exactly the same process occurs, the pigment changes of a black-and-blue spot being isomeric with those that the liver conducts in hemoglobin. Simple staining with ammonium sulphid demonstrates that the duodenum absorbs inorganic or even elemental iron, the absorption being an inclusive process of lymphatic cells. It is not so easy to demonstrate that the iron absorbed is actually assimilated but this seems probable from clinical experience. Although hemoglobin forms a considerable percentage of the entire body, all the iron is represented by a fair-sized wire nail weighing seven grams. Thus it is obvious that an extreme degree of anemia could be counteracted by the administration of some non-corrosive form of iron in a day or two, if the problem were simply lack of iron. I am more and more inclined to regard anemia without obvious cellular disease of the blood as either due to duodenal indigestion or to failure of the conserving function of the liver (and spleen?). At any rate, the treatment of anemia is essentially one of dietetics and nutrition, while the large amount of hemoglobin present in meat justifies the raising of the question whether there is any need of administering either inorganic or proprietary organic preparations of iron as medicines.

Nearly every strict diet, except that of meat and blood, is lacking in iron. It was long a puzzle how the infant, normally subsisting on milk which contains iron in too small a proportion to nourish even an adult, could fail to become anemic. This puzzle is solved by recent analyses which show that the infant starts with a rich store of iron in the liver and spleen.

PHOSPHORUS COMPOUNDS.

Lecithin resembles the fats and contains phosphorus in organic combination. It is found in nervous tissue, also in yolk of eggs, blood cells, semen, bile and milk. It is rather questionable whether it is really an active proximate principle or a waste product. In this connection, it may be remarked that a good deal of what is commonly considered the need of the organism for nitrogenous food, really means the need for phosphorus in organic combination. N and P are closely related elements, both inorganically and according to their analogies in organic combination. The exact significance and method of phosphorus metabolism is, however, not understood.

SCURVY.

There is one dietetic need not explained by a study of the proximate principles of the body. Scurvy has been variously attributed to the need of vegetable acids—which do not appear to be proximate principles of the body itself, though formed by fermentation in the alimentary canal—of potassium, which is abundant in the very foods that cause scurvy, or as due to a specific bacterium —which surely is least to be expected in desert islands and the arctic regions—or to some chemic poison contained in food—an apparently adequate theory in some cases but scarcely as applied to those due to cereal infants' foods. It seems better to accept it as an empirically recognized fact than to rely on an unsatisfactory theory. Scurvy is by no means exclusively a disease of cast-aways, poorly fed sailors nor of the pulpy, artificially reared babies whose pictures are found in the advertising pages of popular magazines. It is not infrequent, though probably not observed in typic form and therefore overlooked, in adults or children who simply do not care for fruit and vegetables. It is probably of the same general nature as purpura and is possibly due to some interference with globulins. At any rate, we have the empiric fact that infants need uncooked milk and that adults require either some amount of raw vegetables or fruit, or at least that their diet shall not consist too exclusively of preserved foods.

CHAPTER IV.

DIETETIC NEEDS IN HEALTH.

AMOUNT OF VARIOUS KINDS OF FOOD NEEDED.

Partly as the result of computations from the amount of oxygen inspired and the amount of the various excreta but also from empiric study of the appetites of collections of healthy individuals in barracks, prisons, etc., in boarding clubs and some few investigations of private families' food supply, various estimates have been made of the daily ration required to maintain health. The table on the following page is taken from W. Gilman Thomson's excellent work on Dietetics.

Approximately, we may say that, according to weight, exercise, etc., the daily requirement of proteid is 100—125; of carbohydrate 300—500; of fat 50—100 Grams. The albuminoids—meaning gelatin for practical purposes—may supplant about one-fifth of the proteid, by preventing oxidation, not by forming tissue, but, for each Gram of proteid supplanted two of gelatin must be given, so that the maximum of gelatin is 50. Usually, not more than two or three Grams a day are taken in soup, etc., nor more than five in jellies. Sodium chlorid is needed to the amount of 15—25. Of other salines, iodin, iron, etc., no provision is made by the appetite, but a great abundance is furnished in an ordinary mixed diet and, per contra, we cannot be sure that enough is being taken of these various mineral constituents, unless the diet has a considerable variety.

	Age and Conditions.	Protein Grammes.	Fats Grammes.	Carbohydrates Grammes.	Total Grammes.	Potential Energy Calories.
1.	Children to 1½ years...	28 (20-36)	37 (30-45)	75 (60-90)	140	767
2.	Children of 2 to 6 years	55 (36-70)	40 (35-48)	200 (100-250)	295	1418
3.	Children 6 to 12 years..	75 (60-80)	43 (37-50)	325 (250-400)	443	2041
4.	Aged women	80	50	260	390	1859
5.	Aged men	100	68	350	518	2477
6.	Women at moderate work (Voit)	92	44	400	536	2426
7.	Man at moderate work (Voit)	118	56	500	674	3055
8.	Man at hard work (Voit)	145	100	450	695	3370
9.	Man with moderate exercise (Playfair)	119	51	531	701	3139
10.	Active labor (Playfair).	156	71	568	795	3629
11.	Hard labor (Playfair) ..	185	71	568	824	3748
12.	Woman with light exercise (Atwater)	80	80	300	460	2300
13.	Man with light exercise (Atwater)	100	100	360	460	2820
14.	Man at moderate work (Atwater)	125	125	450	700	3520
15.	Man at hard work (Atwater)	150	150	500	800	4060
16.	Man at moderate work (Moleschott)	130	40	550	720	3160
17.	Man at moderate work (Wolff)	120	35	540	695	3032
18.	Adult at moderate work (Landois & Stirling)..	120	90	330		
19.	Average from above (Mrs. E. H. Richards)	(110-125) (100-125)	(90-125)	(420-450)		3000-3500
20.	Bare subsistence ration (Mrs. E. H. Richards)	75	40	325		2000
21.	Average estimate (Vierordt)	120	90	330		

Minimum diet, moderate labor and 2818 G of water.

WATER IN DIET.

Of the water, in addition to the 500 Grams formed in the body, 2,000 are needed, of which about half is normally taken as water, though many persons, women especially, fail to realize the excellence of this beverage and drink too little. Ordinarily, a glassful of water should be taken at each meal, aggregating 750 Grams, and the remainder between meals. Not more than 1,000 c.c. of liquid and solid should be introduced into the stomach at any one meal, so that if other beverages are used, it is better to take almost no water at meals, but to drink the 1,000 c.c., or four glassfuls at various times between meals and in the evening.

CALORIES, OR HEAT ENERGY.

Within the last few years it has become the custom to estimate the amount of food needed in terms of calories or heat units. The term calorie simply means the amount of heat energy, potential or kinetic, that will raise a unit weight of water a unit of temperature, under certain conditions of atmospheric pressure, etc., which need not be considered. Ordinarily, by calorie, is meant the heat energy necessary to raise a kilogram of water a degree centigrade. Heat energy is required by the body to the amount of 3,000 or 3,500 calories daily. Some writers use the Gram-calorie, and their numbers are millions instead of thousands. In some old books, heat units based on pounds, ounces, grains and Fahrenheit degrees may be encountered. The complete oxidation of one Gram of starch to CO_2 and H_2O, liberates 4.1 calories. The similar oxidation of one Gram of fat liberates 9.3 calories. Proteids can not be completely oxidized in the body, H_2O and CO_2 being formed which cannot be further oxidized, but urea, N_2H_4CO, obviously retaining considerable potential heat energy. The physiologically, but not chemically, complete oxidation of proteid in the body liberates 4.9 calories per Gram.

The Gram-calorie, between the temperatures of 150 and 175 C, has been calculated to be equivalent to the force required to raise 1 G., 427.5 meters.

The number of calories required by the body, daily, is influenced rather by the capability for radiation and evaporation than by the weight of the individual. Evaporation depends in large degree upon exercise but also upon certain individual differences of recondite cause, but which may theoretically be ascribed to differences in histologic development of the sweat glands, freedom of circulation in the skin and functional activity of the epithelium of the sweat glands. If these factors are assumed to be equal, radiation and evaporation depend largely upon the area of the surface of the body.

HEAT ENERGY REQUIRED.

The average man, requiring 3,000 calories daily, has a superficial area of about 21½ square feet and it is said that the requirement in calories corresponds quite accurately to the superficial area. Thus, contrasting two men of equal weight, one short and fat, the other tall and thin, the latter requires more calories than the former simply because he has more surface for heat dissipation. It is merely a corollary of this proposition that a person who becomes fat upon a certain diet, tends to reach a point of equilibrium simply because the deposit of fat increases the radiating surface. But the rate at which this point is reached gradually decreases because the fat itself lessens the radiation of heat. Still, it must be conceded that heat dissipation by insensible perspiration is always far in excess of mere radiation.

The amount and the texture of the clothing has an important bearing on heat radiation and evaporation and that this point is no imaginary one is evinced by the difficulty of overcoming leanness in a person who is insufficiently clad. Heat dissipation is divided approximately as follows: by the skin, mainly evaporation, 77.5 per cent; by the lungs 15 per cent; by warming air in lungs 5 per cent; by warming ingesta 2 per cent, varying several per cent either way from zero; by feces, urine, etc., 0.5 per cent.

While interesting from some standpoints, the caloric estimation of food values is of no practical use in dietetics because food includes material for repair as well as fuel, and because, on the one hand, the body is not adapted to consuming much over 100 Grams of fat a day, and, on the other, it seems to require not much less than 50 Grams of fat as such, and even that some proteid be ingested for fuel, in order to distribute the digestive work equably among the various organs.

The temperature at which food and drink is taken, adds to the relish and may temporarily aid in regulating the temperature of the body. The continued use of ice or other very cold substances dries the tongue and may produce an almost intolerable sense of discomfort due to glossitis. The traumatic effect of very hot ingesta is well known. The alternation of heat and cold tends to crack the dental enamel and to induce catarrh of the food passages. The ingestion of a considerable quantity of cold water, ice-cream, etc., when overheated has caused sudden death, either from reflex shock through the pneumogastric or from the transmission of cold to the heart. After the analogy of inspired air, ingesta are very rapidly cooled or warmed to the temperature of the body, hence the folly of swallowing bits of ice to check gastric hemorrhage is obvious. If not mechanically dangerous, the use of hot or cold water as a styptic might be of some value through the tube. It is noticed that the lower animals, even domesticated as pets, rarely acquire a human taste for hot and cold ingesta, so that our habits of eating and drinking may be considered strictly conventional. However, with reasonable care, there is little practical objection to following the prime culinary injunction to serve "hot things hot and cold things cold."

WASTE OF NUTRIMENT.

A considerable amount of food purchased is wasted, either in the physiologic or economic sense. Unless under the compulsion of abject poverty, there is no reason in urging the swallowing of gristle, rind, unpalatable meat fat, or vegetable matter consisting largely of cellulose. Physiologic waste appears small if we confine our examination to the soluble filtrate of feces, neither albumin, peptone nor sugar being normally present except in traces. Undoubtedly, however, some unused proteid and sugar is destroyed by intestinal bacteria. Some fat and a greater amount of fatty acid in the form of insoluble soaps of Ca and Mg, are always wasted. Epithelium, dense connective tissue of meats and corresponding cellulose structures of vegetable origin, as well as very large masses of almost any consistent nutriment, are wasted with their contained digestible material. Normally, however, unless the diet is mainly of coarse vegetable products, the feces contain more waste than wasted matter; in other words, more than half of the solid portion of feces is catabolic excretion and not merely excrement in the popular sense. Trypsin also, normally digests part of the proteids beyond the nutritious stage, into leucin and tyrosin, a very wise provision against superalimentation.

The economic waste of food varies greatly, according to circumstances. Atkinson cites two observations on boarding clubs, in which the nutriment wasted amounted to only 10 and 15 per cent, respectively, of the total theoretically present in the food purchased. He also cites a "well-to-do" private family which wasted only 1 per cent of the food purchased. But so low a percentage either means that the nutriment of marrow, irregular and small masses of muscle and fat was not counted or that the diet was painfully restricted to articles that require no trimming, or that there was little need of dish washing and much use of rehashed foods. Under ordinary circumstances, probably not much over half the nutriment bought is actually utilized, after allowing for economic and physiologic waste, including the destruction or failure to absorb nutriment taken in excess of the actual need of the body.

PROPORTION OF FOOD UTILIZED.

It is difficult to determine accurately the utilization of ingested food on account of the fact that, under an average mixed diet, about half of the fecal mass consists of genuine excreta and half of unused food, including strictly indigestible particles, such as seeds and other dense masses of cellulose, epithelium, bone, etc., and other particles that should theoretically have been digested but which have been lost through inclusion in an indigestible envelope or through mere imperfection of digestion and absorption. It is, of course, easy to select milk curds, tendon ends, bits of cartilage, etc., as well as fragments of certain coarse vegetables and fruits. Under an experimental diet or one due to poverty, in which large quantities of turnips, carrots and similar vegetables are ingested, to the practical or complete exclusion of other articles, the feces are bulky and consist mainly of slightly altered fragments of the food stuff in question while the loss through failure of digestion and absorption is relatively very high. Under ordinary diets, it is impossible to pick out or to filter and identify the remains of ingested foods and to distinguish them from body waste, while it is obvious that the chemic analysis fails to reveal the extra- or intracorporeal source of nitrogen, carbohydrate, etc.

Robert Hutchison, relying mainly on researches of Rubner and Atwater, draws conclusions which, with some qualifications and modifications, may be summarized as follows:

UTILIZATION OF MEATS, FISH, EGGS AND MILK.

Soft parts of all meats, fish, eggs and milk, excepting abnormal conditions in which curds or fragments of meat, etc., are visible in the feces, are digestible to the extent of about 98 per cent of proteid and nearly 100 per cent of carbohydrate, when any is present, as in milk and liver. The digestibility of the fat of meat and fish is from 79 to 92 per cent, of eggs 96 per cent, and of milk 93 to 98 per cent. Butter, oleomargarin and clear fats generally, are digested and absorbed to the extent of 95 per cent.

UTILIZATION OF CEREALS AND VEGETABLES.

The utilization of cereals depends largely upon the state of comminution. Their carbohydrate is generally more completely utilized than the proteid on account of being more readily dissolved while their fat is so low that it is impossible to state just how thoroughly it is utilized. In all discussion of carbohydrates, it should be noted that the term is used in the physiologic, rather than the more inclusive chemic sense, and that cellulose is not counted as available carbohydrate. Of fine wheat bread, the utilization of proteid is 81 per cent., nearly 100 per cent., and of carbohydrate 99 per cent., while the figures for bread made of decorticated but otherwise "whole" wheat, not so finely ground, are, respectively, 69½ per cent. and 92½ per cent. In general, we may depend upon the utilization of 70 to 80 per cent. of proteid and 95 per cent. of carbohydrate of cooked and softened green or canned cereals or the dried kernels made into purees and soups.

From potatoes, about 80 per cent. of proteid and practically 100 per cent. of carbohydrate is absorbed, if a puree is made, while, as ordinarily cooked, the utilization is only 70 and 92 per cent. respectively.

From the coarser vegetables, such as cabbage, carrots, beet roots, etc., 60 to 80 per cent. of proteid and 80 to 85 per cent. of carbohydrate is absorbed.

CHAPTER V.

FOOD REQUIREMENTS IN TERMS OF NATURAL FOODSTUFFS.

W. Gilman Thompson and others have compiled tables of the value in terms of proteid, fat, carbohydrate and sometimes water and salines, etc., of the various meats, fish, shellfish, cereals, fruits, vegetables, etc., as determined by analysis. The expense and delay of making analyses for a single patient are almost prohibitive, while the investigations that have been made on students in this country are only of approximate value, as the victims have supplemented their regular diet, sometimes to a marked degree. As the entire matter is based on approximations, I have compiled the following table as representing an average of various analyses, expressed in percentages of the commercial food-article. As, in most instances, the range of analysis may vary several per cent, I have had no hesitancy in fixing the proportion of an ingredient at a multiple of 5 per cent whenever this represented an average analysis or an inappreciable error, from the practical standpoint. I have omitted also all minute percentage proportions, when the amount of the food article that could be given in a day would be too small to allow a notable quantity of the minor ingredients to be introduced. The unspecified percentages necessary to make 100 per cent represent mainly water, but also salts, fibrous tissue, cellulose and other indigestible residue.

Fresh fruits are omitted from the table, as they are of practical value only as antiscorbutics and as appetizers, or as an agreeable means of introducing water. They contain minute amounts of proteid, some of them a little oil, but even their principal organic constituent, glucose, is too low to be of practical value unless a great excess is eaten.

TABLE OF FOOD VALUES.—A. L. Benedict.

	Proteid.	Fat.	Carbo-hydrate.
Milk	4	4	4
Good cream	3.5	25	3.5
Cream cheese	25	30	5
Butter	..	90	..
Lean meats, poultry and game	20	1	1
Fat meats, especially pork and mutton	15	35	..
Bacon and salt pork with lean streak	8	70	..
Solid fat, salt pork, etc	1	80	..
Smoked ham	20	40	..
Fresh fish	20	2	1
Oysters	5	..	..
Shell fish	15	10	..
Canned salmon, etc	20	13	1
Eggs, without shell	13	11	..
Bread	8	1.5	50
Biscuit	15	1	73

Crackers	10	9	70
Dry cereals "breakfast foods"	10	6	64
Macaroni	10	..	75
Tapioca and corn starch	..	..	98
Potatoes	2	..	20
Dry peas and beans	25	2	55
Canned corn, beans, etc	3	1	13
Cabbage, sprouts, lettuce, etc.	2	1	5
Dried apples, etc	1	2	70
Solid, dry chocolate	20	50	10
White sugar	..	..	98
Brown sugar	..	..	97
Syrup	..	..	55
Lard	..	85	..
Bananas (50 per cent waste)	15	..	23

Each banana, net, 45 G.

It is apparent from a glance at this table that very few food stuffs may be considered as belonging to any one of the organic groups of food, even for practical purposes, and that no one kind of food is so constituted as to furnish the body with its proportionate requirements of the three organic groups, even if we neglect entirely the important inorganic necessities.

AMOUNT OF FOOD REQUIRED.

To obtain the necessary amount of proteid, one would have to consume in a day, 538 Grams of lean meat; 796 of wheat flour; 905 of eggs, i. e., 18 eggs; 989 of corn; 1,868 of rice; 2,905 of milk; 4,575 of potatoes; 4,796 of lard. To obtain the needed quantity of carbon, in organic combination, one would need at least 450 Grams of lard; 801 of corn; 824 of wheat flour; 896 of rice; 2,231 of eggs, i. e., 43 eggs; 2,620 of lean meat; 3,124 of potatoes; 4,652 of milk. In order not to overtax the digestive organs, it is best to employ a mixed diet, including some articles rich in proteid, others composed mainly of carbohydrates, others mainly fatty in their nature. The digestive functions are not perfectly performed, hence slightly more nutriment is needed than would correspond to the theoretic amount necessary to make good the waste of CO2, urea, etc. To support life on a mixed diet, nearly 2-1000 of the body weight of proteid must be consumed daily. On a diet of meat alone, 1-100 of the body weight of proteid must be consumed, equivalent to five times as much lean meat. Ordinary diet of Americans is much in excess of the needs of the body, especially in proteids.

KINDS OF FOOD REQUIRED.

For practical purposes, we may consider lard, butter, salad oils and salt pork and bacon, without a streak of lean meat, as pure fats. Sugar, syrup, bananas, potatoes, tapioca and corn starch may be considered as pure carbohydrate; lean meats, oysters, shell fish, as pure proteid, disregarding inorganic material and waste. On a *varied* diet, we may neglect the iron, iodin, salts, etc., except that about 15 Grams of NaCl will be required daily, feeling confident that the body can extract its other mineral ingredients in sufficient amount. For brief periods we may also neglect the mineral ingredients except NaCl and calculate only the amounts of proteid, fat and carbohydrate required on a *restricted* diet. But no physician has the right to order for any length of time an exclusive diet of milk, eggs, meat, cereal, etc., to an adult, unless he has the chemic knowledge, both theoretic and analytic, to calculate whether the mineral needs of the body are being subserved. So far as I know, no one has this knowledge, as yet.

Allowing for a considerable range in the proportions of proteid, fat and carbohydrate required, or, in other words, for the practical degree to which vicarious use of these respective kinds of food is allowable without overtaxing certain digestive and excretory functions and allowing others to fall below par from non-use, the ingesta must fulfill quite closely, one of the three following proportions:

Proteid : Fat : Carbohydrate :: 2 : 1 : 10
Proteid : Fat : Carbohydrate :: 1 : 1 : 4
Proteid : Fat : Carbohydrate :: 2 : 1 : 4

Many have been misled by the fact that eggs and milk are, respectively, the complete natural sustenance of the developing mammal and bird, into supposing that these are likewise capable of nourishing indefinitely the human adult. The commonly employed similes, by which the body is compared to an engine and the food to fuel, are also misleading as the food corresponds to both fuel and material for repairs. It is perfectly true that, as a matter of emergency, and, to a limited degree, normally, all kinds of food are used to produce energy, whereas the engineer could scarcely utilize bolts and nuts as fuel to any practical degree though they might literally be oxidized at the high temperature of the fire pot. When we come to the consideration of milk and eggs, the simile is especially misleading because the engine is practically completed before any fuel at all is needed, while the body is being built during about a quarter of its lifetime. In the period of growth, especially early infancy, when the total weight of the body increases three or four times in a year, it is obvious that a relatively large amount of proteid is required, while the little engine is being run at almost no mechanic resistance, and, therefore, requires relatively less fuel. But, we must also bear in mind that fat, which is practically a fuel only in the adult, the amount deposited in the tissues preferably remaining stationary, must be laid down pari passu with the formation of active organs by the child. The lack of iron in milk and the reason that the child does not suffer therefrom have already been mentioned.

PHYSIOLOGIC NEEDS.

The requirements of the organism are too elastic to allow a solution by algebra, of the problem of converting the needs of the body into terms of ordinary foods. By "cutting and trying" we may make out various menus that shall represent closely the physiologic needs of the body. Mrs. E. H. Richards has suggested the following for an adult not engaged in active exercise:

	Gm.	Oz.	Proteid.	Pat.	Carbo-hydrate.
Bread	453.6	16	31.75	2.26	257.28
Meat	226.8	8	34.02	11.34	.....
Oysters ...	226.8	8	12.52	2.04	.....
Cocoa	28.3	1	6.60	7.50	9.60
Milk	113.4	4	3.63	4.42	4.88
Broth	453.6	16	18.14	18.14	90.72
Sugar	28.3	1	....	....	27.36
Butter ...	14.17	½	.14	12.27	....
Total nutriment.....			106.80	57.97	389.84

The "carbohydrate" in broth must mean gelatin. If one were to criticize this ration, it would be mainly from the standpoint of the palate. The amount of milk allowed for cocoa is very small, only half of an ordinary cupful for the entire day. Much better cocoa is made of entire milk plus the powdered chocolate made into paste. The allowance of oysters is rather large, except for a single day's ration not to be repeated. The bread is rather high and most persons would prefer to replace part of it with potatoes, when a larger amount of meat would be needed. The sugar is very low, not much over a quarter of that taken by choice.

VARIETY OF FOODS REQUIRED AND APPETITE.

No attempt will be made to discuss dietaries for garrisons, hospitals, prisons, etc. Tables of rations carefully calculated to fulfill the requirements of the body at a minimum cost may be found in reports of various army and navy commissions, hospital boards, etc., and some of these are reproduced by Thompson. Healthy persons in good circumstances naturally and properly demand a greater variety and less insistance on financial or physiologic economy. Indeed, it is doubtful if proper secretory activity can be maintained without an appetite and an appetite can not be maintained in a person of somewhat sedentary habits without a wide variety of tasty food. Whenever it becomes necessary to investigate the quantity of the three kinds of organic food taken by a person in health or mild invalidism, it is best to start with a sample day's ration as chosen by the person himself, to analyze this and to suggest additions or subtractions as necessary. For clinical purposes, "analysis" may be done from tables, knowing the weight of bread, meat, etc., which the patient takes. It may be convenient to remember that an ordinary tumbler or full-sized cup holds about

250 c.c., that a slice of bread is about 25—50 Grams, and that it takes about 1/10 Gram of butter for each Gram of bread as a liberal allowance, and including butter eaten with other food.

Most persons in health probably do not strike a close balance between bodily needs and food ingested on any one day. Sometimes all three kinds of food overrun, sometimes all are deficient. Again, the proportions of the three kinds of food depart from the normal, to be compensated for by corresponding repugnance to certain foods and craving for others, with the obvious consequence in the nature of the food ingested. To hold that the food taken should always be in theoretic proportion, is equivalent to saying that there should never be an appetite except for food in general. If the desire for a particular kind of food is abnormal, it is only a step in advance to say that one should normally be unable to distinguish between hunger and thirst.

AVERAGE DAILY FOOD REQUIRED.

Atwater and Rockwood have computed the following diet lists as approximate equivalents of the daily ration of 125 proteid, 125 fat and 450 carbohydrate, required by an adult male engaged in manual labor of average severity. They have carefully computed the cost for each ingredient but, on account of variation in prices, only the total daily cost is given here and this must be regarded as only approximately correct.

Liver, ½ pound
Potatoes, 1 pound
Butter, 1 ounce
Bread, ½ pound
Corn meal, 1 pound
Cost, 14 cents

Beef shin, ¼ pound
Fresh cod, ½ pound
Oatmeal, ⅛ pound
Bread, ½ pound
Potatoes, 1 pound
Milk, ½ pint
Corn meal, ½ pound
Butter, 1 ounce
Boston crackers, 2 oz.
Cost, 16¼ cents

Round steak, ½ pound
Milk, ½ pint
Bread, ½ pound
Potatoes, 1½ pound
Turnips, ½ pound
Corn meal, ⅛ pound
Butter, 1 ounce
Cheese, 1 ounce
Sugar, 1½ ounce
Cost, 19½ cents

Soda crackers, ¼ pound
Potatoes, 1 pound
Bread, ½ pound
Shad, ¼ pound
Eggs (5), ¼ pound
Oatmeal, ⅛ pound
Rice, ⅛ pound
Sugar, ⅛ pound

Beans, ¼ pound
Butter, 1 ounce
Cost, 21 cents

Oyster crackers, ¼ lb.
Oysters, ½ pound
Leg of mutton, ¼ lb.
Peas, ⅛ pound
Oatmeal, 1 pound
Rice, ¼ pound
Bread, ½ pound
Butter, 1½ ounce
Cost, 29 cents

Turkey, ½ pound
Fresh pork, 2 ounces
Hominy, ½ pound
Potatoes, 1 pound
Rye Bread, ½ pound
Milk, 1 pint
Cost, 31 cents

Salmon, ¼ pound
Beef sirloin, ¼ pound
Oysters, ½ pound
Dry beef, 1 ounce
Wheat bread, ½ pound
Oatmeal, 2 ounces
Rice, 2 ounces
Potatoes, ½ pound
Sweet potatoes, 1 lb.
Cabbage, 2 ounces
Turnips, 2 ounces
Butter, 2 ounces
Milk, 1 pint
Sugar, 2 ounces
Cost, 45 cents

Waller has estimated the standard daily ration as follows

	Grams of C	Grams of N
1 pound bread	117	5.5
½ pound meat	34	7.5
¼ pound fat	84	...
1 pound potatoes	45	1.3
½ pint milk	20	1.7
¼ pound eggs	15	2
⅛ pound cheese	20	3
	335	21

This may be divided as follows: Breakfast, two slices of bread and butter and two eggs; dinner, one plateful potato soup, one ordinary helping of meat with some fat, four moderate sized potatoes, one slice bread and butter; tea, glass of milk and two slices of bread; supper, two slices bread and butter and cheese. This omits ordinary beverages with sugar and it is obvious that an ordinary hearty eater, male or female, consumes much more than this.

CHAPTER VI.

SPECIFIC FOODS—FATS, CARBOHYDRATES, PROTEIDS.

FATS.

Butter, suet, lard, olive and cotton seed oils, the proprietary combinations of animal and vegetable oils for frying, fat meats, especially salt pork, bacon and ham, cream, certain chocolates and cod liver oil are the principal fatty foods. It must be remembered that the deposition of fat in the body, though needed to prevent excessive heat radiation and for cosmetic purposes, should not exceed a reasonable amount, and that mere storing of fat is not an index of health nor of extraordinary digestive power, but of failure of oxidation. Obese persons are often, if not usually, light eaters, and they may avoid fats for years without benefit. It seems highly probable that leanness depends on an active power of oxidation of fat, obesity on the reverse condition. From analogy, we may argue that fat is oxidized in the body as the result of a ferment and the thyroid treatment of obesity, though somewhat disappointing, suggests that the suppositious ferment may be secreted by the thyroid. Possibly the frequent failure of thyroid therapy is due to the destruction of the ferment, while the iodin compound remains. Whether we are trying to increase or diminish fat deposit, we must remember that the body probably has the power to form fat from either of the other organic foods, or, at any rate, that either may spare the waste of fat. Thus, the whole dietary must be increased or diminished nearly symmetrically. For increasing the ingestion of fats, I prefer to rely on butter, cream, good salt pork, and other meat fats, according to the patient's taste, and cocoa.

Cod liver oil I regard as oil plus hepatic excreta, plus possible putrefactive toxins, plus biliary salts, plus iodin and other compounds. The first is essentially the same as any other oil. The excreta and putrefactive toxins, which latter may be absent, are distinctly contraindicated. The biliary salts are almost never deficient, and the deficiency if it exists, may be supplied by their administration in pure form or in other preparations of bile. If there is need of iodin, it can easily be given in any desired form and dose. Of course, there is no answering the mineral water argument as applied to cod liver oil. If one believes that nature's accidental poly-pharmacy, of a lot of common minerals in appreciable amount and certain rare substances in traces, will perform a therapeutic miracle, there is no use wasting time on the discussion. Fortunately, some patients acquire a toleration for cod liver oil, and, if it can be borne, the emunctories can usually be trusted to get rid of the extra burden of waste matter.

Cocoas are variously advertised as rich in nutritious fat and free from indigestible fat. One, of excellent flavor, is advertised as containing predigested fats, though its taste does not suggest glycerin and soluble soaps. The fat-free cocoas are usually adulterated with mucilaginous meals. Thus, from the standpoint of organic nutriment, we may select either a starchy or a fatty cocoa, though, in both kinds, there is more or less of both these ingredients. In spite of the declarations of the agents of fat-free cocoas, oleum theobromæ is both pleasant and digestible.

CARBOHYDRATES.

The commercial forms of sugar, excepting the lower grades of moist brown sugar, are nearly pure saccharose plus water of crystallization. Maple sugar and the various syrups are usually adulterated, but as the adulterant is usually pure glucose, or cane sugar, no harm is done. Excepting the cane, beet and maple, most vegetable sugars are dextrose or levulose, or both. Honey, which is simply a bee's extract of flowers, is mainly dextrose. Beer and the malted breakfast foods theoretically contain maltose, practically they are likely to have been adulterated with glucose. Milk and its derivatives contain lactose, while the carbohydrate of animal origin is principally glycogen, and this is found chiefly in the liver. It is usually noted that the appetites for sugars and for starch are complemental, which is natural, since the various sugars are more or less digested forms of starch. The dextrins, obtained by toasting bread and crackers, and present to a considerable degree in crusts, are intermediate between starch and the disaccharids. Lactose, maltose and saccharose are products probably due to ferment action of the mammary glands, the salivary and pancreatic secretions and of certain vegetable cells, respectively. If we compare starch to albumin, the disaccharids may be compared to albumoses, while the monosaccharids, dextrose, levulose and galactose, whether produced in the animal economy from starch or in the laboratory of the plant or in the glucose factory, may be compared to fully digested peptone.

SUGARS AS FOODS.

The very common prejudice against sugars, and especially against glucose, is justified only as the administration of any more or less predigested food is objectionable and as the hygroscopic properties of sugars render them irritating. In reasonable amount, allowing free dilution by the digestive secretions, sugars are scarcely objectionable. That there is a natural appetite for them, among all but nearly carnivorous animals, including human beings, is shown by the fondness which most animals manifest for fruit and artificially concentrated sugars and by the avidity with which a bear or other wild animal attacks a bee tree. The appetite for sugars, as for fats, is increased by exposure to cold and physical strain. To guard against a mere palate-appetite, it is well to restrict sugars in ordinary dietaries to the latter part of the meal, as, indeed, is the common domestic custom. The idea that sugar is harmful really does produce harm, as the natural appetite is sometimes resisted on account of this belief, till it becomes irresistible, when an overindulgence follows. The same alternation of unnecessary abstinence and overindulgence occurs with regard to meat by certain weak vegetarians and in regard to salt, condiments, etc., by various health cranks. From averaging the sugar consumption for 37 persons in good circumstances, all adults except three children, aged 14, 6 and 4, respectively, I have found the daily per capita consumption to be 125—130 Grams. The sexes were about equally divided and all were in fair or excellent general health. None were exercising violently. While there was undoubtedly some waste of sugar, this must at least have been counterbalanced by candy and fruit eaten between meals.

TAPIOCA, CORN STARCH, POTATOES AND BANANAS.

Tapioca and corn starch are nearly pure starch. Potatoes contain only a tenth as much proteid as starch. Bananas are peculiar and patients must be warned that they are not to be included with other fruits. Among civilized peoples, bananas are the only form in which raw starch is ingested in any considerable amount. Except for the small amount of sugar and proteid which they contain, they are entirely indigestible in the human stomach, as ptyalin digests only cooked starch, whereas amylopsin is much stronger and can penetrate the capsule of cellulose in which the starch is inclosed. When there is no marked tendency to fermentation in the stomach and its motor power is normal, bananas are an excellent food. A banana meal, similar to other cereal meals, is obtainable, and this is, of course, digestible in the stomach, subject to the ordinary limitations of combined starchy and proteid vegetables. Cooked bananas have rather a rank flavor, unless previously prepared, but may be used according to the taste of the patient. Regarding the economics of the nearly pure carbohydrates, it may be convenient to remember that a pound of sugar is equivalent to about five pounds of potatoes. As there are 60 pounds in a bushel of potatoes, potatoes at 60 cents a bushel are equal in expense to sugar at 5 cents a pound.

PROTEIDS.

The various lean meats differ slightly in organic and inorganic analyses, but the principal difference is according to the amount of fat. Pork and mutton, commonly called *lean,* contain much more fat than beef. With this proviso and remembering that the fat of poultry and especially of fish, is more easily separated than that of the quadrupeds, almost all animal muscle analyses about the same.

COOKED VS. RAW MEATS.

While, in theory, it is more "natural" to eat flesh raw, it does not appear that moderate cooking renders it difficult of digestion, while the killing of possible parasites, animal or bacterial, is a very important argument against the use of raw meat. The respective tape-worms of beef and pork, trichinæ in the latter and tubercle bacilli especially in the former, render these meats subject to suspicion, unless quite thoroughly cooked. It is perfectly possible that many cases of tuberculosis originate in invalids whose resistance is below par and who have been fed on beef juice, raw meat balls, etc. Mutton is relatively free from the danger of communicating parasites of any kind, but its flavor is not adapted to its use as a raw nutriment. Granting that there is no objection to thorough cooking, I am inclined to believe that the prejudice against pork and in favor of beef, is scarcely warranted.

Aside from various kinds of chronic disease, mild forms of sepsis from local injuries of animals in freight cars, must be considered as of practical importance, and these injuries are obviously—and statistically—more apt to occur in cattle than in the smaller quadrupeds. It is to be hoped that the modern improvements in refrigerator cars, and a growing realization of the harmfulness of eating bruised meat or the uninjured parts of animals in a febrile condition, will soon put an end to the horrible cruelty of transporting live animals for slaughter.

COMPARATIVE VALUES OF ANIMAL FOODS.

It is still a moot point as to whether similarity of diet has anything to do with the relative food value for human consumption of the various meat animals. In a general way, it is held that the omnivorous or herbivorous mammals afford better food than fish, shell fish, fowls and carnivorous mammals. Carried to its limit, this argument should favor the superiority of pork as nutriment for the human being. Cannibals state that the flesh of swine and human beings have a very similar flavor; indeed, in the South Pacific islands, these meats were known as short and long pork, respectively. Nevertheless, the constitution of the various animal muscles is so nearly alike, whether derived from mammals, birds, fish or shell fish, and whether the light or dark muscle of those meats which show such a difference is used, that any choice for practical purposes must depend on the individual palate, liability to infection with parasites and digestibility. Any meat that is disgusting to an individual, whether the dislike is well grounded or not, is apt to cause reflex secretory failure, and vomiting.

The ingestion of the excretory viscera, the liver and kidneys, can not but introduce excrementitious matter, though probably not in sufficient amount to do any harm, unless there is a genuine weakness of the corresponding emunctories. Shell fish are especially likely to be contaminated from sewage and only thorough cooking can do away with the danger of conveyance of typhoid and possibly other specific diseases. Mammalian meat seems, on the whole, to be more readily digestible and to furnish proteid more nearly in accordance with the requirements of the human body than sea-foods. Owing to quicker time and better care than formerly, the danger of "ptomaine" poisoning from sea foods is not now very great for parts of the country within 500 miles of the coast. For some reason, salt-water fish are more appetizing and more digestible for many persons than those obtained from adjacent fresh-water streams and lakes. It is doubtful whether the erythema, urticaria, etc., quite frequently noted after the use of shell fish, are indications of genuine idiosyncrasy, or whether they simply denote greater susceptibility to toxins of putrefaction.

The flesh of immature animals is universally recognized as unfit for food. Why this is so I have never been able to discover. The only explanation that I have ever heard is that the immature flesh is more likely to putrefy than that of older animals, but this is only a potential reason.

METHODS OF COOKING MEATS.

Of the various methods of cooking, boiling is best adapted to the preparation of tough meat, and, at least, for the preliminary treatment of meats from which it is desirable to remove an excess of salines, catabolic principles or pungent odors. Since the general introduction of ovens, baking and roasting are synonymous terms, and this method is most applicable to meat in bulk. Broiling is practically the same process, but applied outside the oven to meat in thin slices. There is a general prejudice against frying, but if the fat is hot before the meat or other food is introduced, there is very little permeation with fat, and, on account of the portability of the apparatus, it has a wide field of usefulness, though not well adapted to invalid cooking.

Smoked, dried and salted meats are usually mechanically difficult of digestion. On the other hand, they are usually aseptic and slightly antiseptic and quite appetizing. We must not forget that even an invalid may ultimately obtain more nutriment, with less fermentative poisoning, from salt cod-fish, smoked ham, dried beef, etc., which he will digest in six or seven hours, than from fresh meat which is disgusting to him and which he will vomit after more or less putrefactive disturbance, instead of digesting it in two or three hours as he theoretically ought to do.

VALUE OF MEAT BROTHS AND SOUPS.

In regard to broths, beef tea, soups, etc., we must not be deceived by the extraction of salines, flavoring matter, catabolic principles, coloring matter and gelatin into the popular belief that the essence of the meat, that is, the proteid matter, is dissolved. With these exceptions, one can no more make a meat broth than an egg broth. Aside from the salts, water and gelatin, and very small amounts of fat and glycogen, there is nothing but excrementitious matter in a broth. But, just as one may commit some minor errand to the care of a departing guest, the body undoubtedly does use certain nitrogenous waste, of the xanthine group, on its way out of the system, to stimulate nerve centers, especially those of intellectual function and those controlling the vessels. It may very well happen that a convalescent, who has been on a reduced diet, may need the stimulating effect of the nitrogenous waste matter extracted from meat, not to mention the other inorganic and minor organic ingredients. And if the broth or beef tea is given unstrained, there is genuine proteid nutriment in the sediment. But, if there is impairment of the nitrogenous emunctories, the liver and kidneys, such extracts are distinctly contraindicated.

USE AND VALUE OF MILK.

Whenever it is necessary to introduce unirritating food comparatively rich in proteid, milk, eggs and expressed meat juice are the main articles on which we must depend. On account of its bulk, insipidity, lack of iron, and the solidity of the curds formed, milk is not a good food for adults in health, to the exclusion of ordinary solid diet, while its use as a supplement to ordinary food may overtax the digestive organs and the emunctories. Yet there is no objection to employing it as an auxiliary food to the extent of allowing it ad libitum with cereals and with the beverages. The danger of communicating tuberculosis is a considerable factor, as, without rigid enforcement of state condemnation of cattle, about 2 per cent are commonly found diseased. Pasteurized milk is nearly free from the danger of tuberculosis, although spores are not killed by anything short of prolonged exposure to boiling. It is of commercial importance to know that Pasteurized milk may be marketed at 6 cents a quart, with profit.

To prevent the formation of large curds, milk should never be drunk like water, but should be eaten with other food or sipped, and swallowed after thorough admixture with saliva. It ought not to be necessary to call attention to the fact that milk is normally coagulated after a few minutes' exposure to gastric juice, but one occasionally meets a physician who shares the lay notion that curdling of milk in vomited matter indicates some grave disturbance of digestion. Whether on account of Pasteurization or of the addition of some preservative, I am unable to state, but occasionally 1 have encountered samples of milk which would not coagulate with gastric juice. As milk is commonly used in the laboratory as a test for rennin, a control experiment with rennin solution of demonstrated activity should always be made before the gastric contents are charged with a deficiency. I am unable to say how far such milk is injurious or lacking in nutritious qualities. It should be borne in mind, however, that the best milk is obtained from inspected cows, gathered with every precaution in the line of cleanliness, cooled and delivered fresh, without artificial methods of preservation. Such milk can be obtained only by individual care and implicit confidence must not be placed in dairies simply because part of the stock is held by physicians and a high price is charged.

USE AND VALUE OF EGGS.

Eggs are well relished by most persons to a moderate extent, but they can seldom be used in sufficient number or for a sufficient time to afford an important part of the dietary. Although containing everything necessary for the nourishment of the embryo chick, the published analyses omit all reference to carbohydrates, so that eggs can not be considered complete food. The yolk contains lecithin as well as true fats. As has been stated, it is doubtful whether the former is a nutriment or a catabolic principle. The white of egg consists of an almost pure saline solution of proteids. Excepting hard boiling or frying, almost any form of cooking may be applied for any case. Eggs are especially valuable when combined with milk, as raw, boiled or baked custard, or with milk and a little flour, as German pancake. The net weight of the shell-less egg is 40—45 Grams, about ⅔ white, ⅓ yolk. The whole egg contains proteid and fat in nearly the requisite proportion, there being a slight excess of fat, so that about 25 eggs a day would be needed to supply the entire requirement of proteid, only 20 to supply the fat. It is very rarely that a person will be found who can take so many eggs, but it is worth while remembering that, theoretically at least, one can be indefinitely nourished on 20—25 eggs a day plus 400 Grams of sugar or starch, or, say, 2,000—2,500 Grams of potato.

USE AND VALUE OF CEREALS.

The ground cereals are commonly made into bread, biscuits, crackers, cakes, pancakes, cookies, doughnuts, waffles, etc. Excess of soda, yeast, products of fermentation, grease, condiments and a tendency to form glutinous masses in the stomach, are the points to be avoided. Toasting partially counteracts the last named evil and dextrinizes part of the starch. In almost all dietaries, we may allow a considerable variety of bread, crackers, cookies, hard rolls, sponge cake and angel food. Corn and rice meal are less apt to become sticky than wheat flour and may, therefore, be allowed with relatively greater freedom in the form of hot breads, muffins, gems, pancakes and waffles.

The various breakfast foods are usually easily digested, but care must be taken to avoid those that contain husk and gritty particles, especially if there is a tendency to gastric stagnation and possibly, too, if there is inflammation of the cecum or appendix. Oatmeal is usually considered more "strengthening" than the other cereals, but its analysis does not justify such a conclusion; its husk is less likely to have been thoroughly removed and it contains an active principle that is mildly toxic if the use is prolonged.

The green leguminous foods, peas, beans, string beans, lentils, as well as corn, are likely to cause trouble if there is any failure of gastric peristalsis on account of the indigestible seed coats; otherwise, they are nutritious, appetizing, antiscorbutic and mildly laxative. Popped corn is a very delicate, digestible form of starch and proteid, too little used. Care must be taken to secure kernels that will pop large enough to allow the white to be bitten off from the scales. Except for the sulphur proteids of beans, these same seeds may be used in the dried state, as bases of soups, purees, etc.

The other vegetables are either fruity, like tomatoes, or they may be considered as fodder for quadrupeds, but as scarcely adapted to human consumption, except as antiscorbutics, although carrots and spinach are said to be valuable on account of containing assimilable iron. On account of the fermentable but innutritious cellulose and the volatile constituents of onions, cabbage, turnips, etc., such plants are not to be thought of when any care is necessary, regarding the digestive organs. The raw, "salad" vegetables, are likely to be contaminated with animal parasites and bacteria, and some German authorities even claim that cancer is communicated through such media.

CHAPTER VII.

SPECIFIC FOODS (Cont'd)—VEGETABLES, FRUITS AND NUTS.

VEGETABLES AND FRUITS.

Nearly all the vegetable products eaten fresh, have marked antiscorbutic properties. Many are diuretic or laxative on account of salines and most are laxative by reason of the cellulose contained. Some are distinctly medicinal, even when in common use as foods, as garlic, celery, etc., although any marked medicinal virtue is necessarily accompanied by toxic possibilities which should and usually do preclude use as a food. As a matter of convenience, vegetable food stuffs may be classified as innutritious, as furnishing notable proportions of all organic foods or as limited in value chiefly to one class of organic foods or to some special inorganic material. Such a classification must be understood as being merely approximate. The writer classifies as innutritious, all substances containing, on the average, less than 5 per cent of any organic nutriment. In general, these vegetables and fruits contain no saline or other mineral matter of special value. The analyses chiefly followed are those of Atwater and Bryant for the U. S. Department of Agriculture as applied to the macroscopically edible portion of each article. Dr. E. W. Allen, Acting Director, has shown the utmost courtesy in supplying information and references for this compilation and the warmest gratitude, both of readers and the writer, is due to him.

INNUTRITIOUS VEGETABLES AND FRUITS.

Asparagus, cabbage sprouts, cauliflower, celery, cucumbers, beet greens, lettuce, rhubarb, sauerkraut, spinach, tomatoes, are practically devoid of organic nutrient value. Cabbage, egg-plant, kohl-rabi, leeks, okra, pumpkins, radishes, contain very nearly 5 per cent. of carbohydrate, exclusive of fiber.

CARBOHYDRATE VEGETABLES AND FRUITS,

containing less than 5 per cent. of other ingredients:

Artichokes, 15—16 per cent. of carbohydrates; beets, 2—15 per cent.; carrots, 6—11 per cent.; dandelion greens, 10 per cent.; turnip greens, 6 per cent.; onions, 3—14 per cent.; parsnips, 8—16 per cent.; potatoes, 13—26 per cent.; sweet potatoes, 16—45 per cent.; rutabagas, 5—9 per cent.; squash, 3—15 per cent.; turnips, 2—20 per cent.; apples, 8—20 per cent.; apricots, 13 per cent.; yellow bananas, 16—30 per cent.; blackberries, 7.5—16 per cent.; cherries, 11—20 per cent.; cranberries, 8—9 per cent.; currants, 12 per cent.; figs, 18 per cent.; grapes, 15 per cent.; huckleberries, 16 per cent.; lemons, 7—8 per cent.; muskmelons, 7 per cent.; nectarines, 16 per cent.; oranges, 1—18 per cent.; pears, 11 per cent.; persimmons, 30 per cent.; pineapples, 9 per cent.; plums, 20 per cent.; pomegranates, 17 per cent; prunes, 18 per cent.; red raspberries, 10 per cent.; black raspberries, 12 per cent.; strawberries, 4—10 per cent.; watermelon, 6 per cent.; whortleberries, 10 per cent. (Note.—Inquiry of the Department of Agriculture has failed to elicit the distinction between huckleberry and whortleberry, the executive office reporting no knowledge of the discrimination made by the analysts. Ordinarily, the terms are used indiscriminately and sometimes include the blueberry.)

PROTEID AND CARBOHYDRATE VEGETABLES.

None of the fruits in common use contain notable proportions of either fat or proteid and even the dried fruits, though ranging in carbohydrate content from 60 to 85 per cent., do not reach 5 per cent. of fat or proteid, in average specimens. It is possible, at least in theory, to prepare flours of several vegetables that shall contain up to 10 per cent. of proteid, but, as ordinarily used, none of the vegetables furnish any considerable amount of fat and only the leguminosæ—beans, lentils and peas—and the graminaceæ can be depended on for proteid. When dried and ground, or popped or parched, corn furnishes about 10 per cent. of proteid, 70—78 per cent. of carbohydrate, and from a fraction of 1 per cent. of fat in hominy, etc., up to about 5 per cent. in the preparations in which nothing is abstracted from the kernels. Of the leguminosæ, the analyses are as follows:

	Proteid.	Fat.	Carbohydrate.
Fresh string beans.......	2.3	0.3	5.5
Fresh butter beans........	9.4	0.6	29.1*
Fresh Lima beans.........	7.1	0.7	20.3
Dried Lima beans.........	18.1	1.5	65.9*
Dried ordinary beans.....	22.5	1.8	55.2
Dried lentils..............	25.7	1	59.2*
Fresh peas	7	0.5	15.2
Dried peas...............	24.6	1	57.5

The analyses are by Atwater and Bryant. In those marked *, fiber is included with carbohydrates, exaggerating the value by 2—4 per cent. The proteid percentages are also more or less exaggerated by the inclusion of various nitrogenous matter under the general term protein. However, the non-proteid *protein* is not quite analogous to extractives from animal tissues and, doubtless, has some food value.

VEGETABLE PRODUCTS RICH IN NUTRIMENT.

Vegetable Products Rich in all Three Classes of Organic Nutriment.—Aside from cereal meals, all ordinarily known vegetable products that contain notable amounts of anything except carbohydrate, are included under the general term of nuts. Or, to state the same truth in other words, plant physiology is such that the seed is the only part in which any considerable proportion of proteid is deposited. Fat is deposited only under the protection of dense fibrous tissue. While fat may be extracted from various plant parts, edibility and fibrous protection are united only in the case of certain seeds which we call nuts. The term nut is not a technical one, but includes several botanic divisions of fruits, the edible portion being the soft part of the seed. That the density of the investment has an actual bearing on the proportion of fat, is well shown by contrasting the peanut with the pea and bean, all being leguminous fruits, differing botanically only in the density of the pod and in the fact that the pod of the peanut tends to bury itself in the ground. The dried bean contains 1.8 per cent. of fat, the dried pea 1 per cent., the peanut 38.6 per cent. Aside from nuts the only vegetable products in common use as foods or food auxiliaries, and containing a notable proportion of fat, are the olive—25—27 per cent.; the green pepper, 8.5 per cent., when dried; the red pepper, 6—10 per cent., and the cacao bean, about 50 per cent. But the last is as much a nut as the Brazil nut. Conversely, the only so-called nut listed by Atwater, that is not rich in fat, is the Chinese lichi, which is not a typic nut in any sense.

FOOD VALUE OF NUTS.

Almonds, beech nuts, Brazil nuts, butternuts, cocoanuts, filberts, hickory nuts, pecans, the various pine nuts, pistachios, black and English walnuts, are markedly fatty, containing from 55—70 per cent. Edible acorns and peanuts contain 35—40 per cent. of fat. The only common nut which is distinctly starchy and not fatty, is the chestnut, which, in the fairly dry state, contains over 70 per cent. of carbohydrate, mainly starch, and only 7 per cent. of fat. The nuts rich in fat, all contain 15—20 per cent. of protein, except the cocoanut, edible acorn, pecan and some kinds of pine nuts. The cocoanut is poorest in protein—6 per cent.—the edible acorn contains 8 per cent. and the pecan and chestnut are about equal in protein value—10 per cent. The butternut is poorest in carbohydrate—3.5 per cent.—the Brazil nut and certain pine nuts contain about 7 per cent., the remaining nuts in common use in this country contain from 10—30 per cent. of carbohydrate, with two exceptions, the edible acorn—50 per cent.—and the (dry) chestnut—70 per cent. Cocoanut milk may be compared to whey, both being poor in fat and proteid, but containing 4—5 per cent. of carbohydrate. Excepting the expense, there is no apparent reason why nuts, reduced to a powder or pulp, should not be used as a food, instead of a relish.

Balland has recently reported to the French Academy of Science, an indigenous tropical African bean, called Voandzou, which is said to fulfill, for practical purposes, the requirement of complete alimentation by a single substance, containing the various organic foods in proper proportion. When raw, it has the flavor of an ordinary bean but it resembles the chestnut when cooked. It contains 10 per cent. of water, 19 per cent. of nitrogenous matter, 6 per cent. of fats and 5 per cent of starch, with 4 per cent of cellulose. This analysis shows that we are still far from a natural fulfillment of a complete food. The plant has been naturalized in southern Asia and, under the name of Mandubide Angola, in Brazil.

Mushrooms have been exploited as food rich in proteid but considerable doubt exists as to their nitrogenous content being in the form of assimilable proteids. On account of the danger of making fatal mistakes as to identity, their expense and the question of their real nutritive value, even when relished and well borne, they cannot be made an important item in diet under medical regulation, though with proper precautions they may be allowed as a relish unless special indications for very limited diet exist.

Dr. A. B. Conklin, in the course of an article in the Medical Review of Reviews, 1902, gives the following table:

Nutritive Value of Foods in 100 Parts.

MEATS.

Poultry	21.	3.8
Lean beef	19.3	3.6
Lean mutton	18.3	4.9
White fish	18.1	2.9
Entire egg	18.	10.5
Veal	16.5	15.8
Salmon	16.1	5.5
Pork	9.8	48.9
New Milk	4.1	9.1
Cream	2.7	29.5

PULSES.

Beans	30.8	50.2
Lentils	25.2	58.6
Peas	23.8	60.8

CEREALS.

Oatmeal	12.6	69.4
Indian meal	11.1	73.2
Whole wheat flour	10.8	72.6
Bread	8.1	52.6
Rye meal	8.	75.2
Rice	6.3	80.2
Barley meal	6.3	76.7

VEGETABLES.

Potato	2.1	22.2
Sweet potato	1.5	27.5
Beet	1.5	11.3
Carrot	1.3	14.7
Turnip	1.2	7.2
Parsnip	1.1	15.9
Cabbage	.9	4.1

FRUITS.

Date	9.	58.
Banana	4.8	20.2
Cherry	.9	15.3
Grape	.8	14.3
Raspberry	.5	6.4
Blackberry	.5	5.8
Currant	.4	5.
Gooseberry	.4	8.9
Peach	.4	7.8
Strawberry	.3	7.1
Apple	.2	10.3
Pear	.2	10.2
Plum	.2	9.3
Sugar	—	95.

CLASSIFICATION OF FOOD MATERIALS BY COMPOSITION.

U. S. Dept. of Agriculture.

GRADATION BY AMOUNTS OF PROTEIN.	GRADATION BY FUEL VALUES.
VERY LARGE.	
Canned corned beef; cheese; beans, dry.	Butter; salt pork; cheese; smoked ham; crackers; sugar; oatmeal.
LARGE.	
Canned salmon; beef, round; beef, sirloin; salt codfish; beef, chuck.	Pork, spare rib; corn (maize) meal; wheat flour, rice; beans, dry; wheat bread.
MEDIUM.	
Mutton, leg; pork, spare rib; beef, rib; eggs; fresh codfish; oatmeal; wheat flour.	Canned corned beef; beef, rib; beef, sirloin; canned salmon; beef, chuck; mutton, leg; beef, round; eggs.

SMALL.	
Smoked ham; wheat bread; milk crackers; corn (maize) meal; rice.	Milk; salt codfish; potatoes.
VERY SMALL.	
Oysters; salt pork; milk; butter; potatoes; sugar.	Oysters; fresh codfish.

CLASSIFICATION OF FOOD MATERIALS BY COST OF ACTUAL NUTRIMENT; I. E., BY COST OF PROTEIN AND ENERGY (FUEL VALUE) AT ASSUMED PRICES PER POUND OF THE FOOD MATERIALS.

GRADATION BY COST OF PROTEIN AT PRICES STATED PER POUND.	GRADATION BY COST OF ENERGY (FUEL VALUE) SUPPLIED AT PRICES STATED PER POUND.
VERY CHEAP.	
Salt codfish, at 6 cents per pound; beans, dry, 4 cents; wheat flour, 2½ cents; oatmeal, 4 cents; corn meal, 2 cents; wheat bread, 4 cents.	Wheat flour, at 2½ cents per pound; corn meal, 2 cents; oatmeal, 4 cents; beans, dry, 4 cents; sugar, 5 cents; rice, 5 cents; potatoes (60 cents bushel), 1 cent; wheat bread, 4 cents.
CHEAP.	
Canned corned beef, at 12 cents per pound; milk (4 cents quart), 2 cents; skim milk (3 cents quart), 1½ cents; potatoes (60 cents bushel), 1 cent.	Salt pork, at 12 cents per pound; crackers, 9 cents; wheat bread, 6 cents.

MEDIUM.

Cheese, at 16 cents per pound; beef, chuck, 12 cents; beef, round, 12 cents; fresh codfish, 8 cents; wheat bread, 6 cents; rice, 5 cents.

Butter, at 24 cents per pound; cheese, 16 cents; smoked ham, 16 cents; pork, spare rib, 12 cents; skim milk (3 cents quart), 1½ cents; milk (4 or 6 cents quart), 2 or 3 cents.

EXPENSIVE.

Mutton, leg, at 12 cents per pound; pork, spare rib, 12 cents; milk (6 cents quart) 3 cents; crackers, 9 cents.

Canned corned beef, at 12 cents per pound; beef, chuck, 12 cents; mutton, leg, 12 cents; beef, rib, 16 cents; beef, round, 12 cents; beef; sirloin, 18 cents; salt codfish, 6 cents.

VERY EXPENSIVE.

Smoked ham, at 16 cents per pound; salt pork, 12 cents; oysters, 30 cents quart.

Fresh codfish, at 8 cents per pound; oysters, 30 cents quart.

CHAPTER VIII.

ADJUVANTS TO FOOD.

THE USE OF TOBACCO.

By common custom most races use one or more mild drugs as adjuvants to food. Tea, coffee, maté, guarana, cola and cacao contain alkaloids very similar to the normal, stimulant, waste products of the xanthine group. Coca erythroxylon and betel nut, though not apparently chemically related, seem to produce similar effects in those habituated.

Tobacco, however used, and alcoholics, depress smooth muscle, either directly or indirectly, and are, probably, not even primarily stimulating, except in the sense that the withdrawal of that for which a habit has been established produces a psychic and reflex sense of depression. Without a definite indication for the use of some of these adjuvants as drugs, it is doubtful whether they are ever to be considered as needed by the body, though it is practically usually better to allow the continuance of a habit than to incur the serious psychic results of a sudden removal. The desire for tobacco usually ceases in acute sickness and its return is often a favorable sign. The advisability of yielding to this appetite must be decided empirically in each case. Usually anything that ministers to the comfort of a convalescent, that takes his attention from his physical condition and that is not obviously harmful, should be allowed. The habit of chewing tobacco usually produces gastric catarrh, with depression of appetite for food and motor irritability, so that vomiting from slight fermentation or psychic stimulus is a frequent symptom. Inhalation of smoke increases the absorption of toxins. Cigars, being usually hand-made and often moistened with saliva, are somewhat liable to convey infection, and, owing to hygienic conditions, cigar-makers are rather prone to tuberculosis as well as to syphilis. Pipe and cigarette tobacco are seldom exposed to contamination with the germs of any specific disease, and milder tobacco can be secured than is used for cigars. An old pipe is, of course, impregnated with nicotine and other derivatives. In general, the cigarette is the mildest and cleanest form of tobacco, whether made by machinery or rolled by the user. It is very rarely that either the tobacco or the paper is adulterated with any other drug. The popular prejudice against the cigarette is entirely unjustified, except as it is especially apt to be used by the immature, and as its comparative mildness and small size tempts to inhalation and excessive use. I am inclined to believe that the chief injurious results of smoking are rather due to carbon monoxid, nitrites and cyanogen compounds, than to nicotine itself. Similar effects are produced by killikinick, and even paper, and the various tobacco substitutes such as dried leaves of trees, corn silk, grape vine and bamboo which children use.

ALCOHOLIC BEVERAGES.

Alcoholic beverages may be divided into those produced by the fermentation of malted grain—beer, ale, porter; those produced by fermentation of fruits—wines, cider, and other fruit wines; ardent spirits produced by distillation of a fermented—or directly fortified—solution of sugar—brandy, whisky and liqueurs.

All things considered, it may be said there is little indication for the use of alcoholic beverages, under any conditions, unless we wish the immediate vaso-dilatation of alcohol or unless it seems unwise to change the habits of the patient suddenly. The question of the food-value of alcohol has, apparently, been settled over and over again, only to be reopened by some new investigator. It can not be disputed that a small amount of alcohol may be consumed within the body, and, having been consumed, it must have produced energy and thus taken the place of a corresponding amount of fat or carbohydrate. From the practical standpoint, I regard it as closely analogous to kerosene as a fuel for an ordinary stove. The body is no more constructed for the regular oxidation of alcohol than is a stove for the oxidation of kerosene. A small amount of alcohol or kerosene, respectively, may be consumed and thus supplant the normal fuel. Such substitution is dangerous but allowable in an emergency.

THE USE OF BEER.

Beer is often recommended on account of the supposition that it is highly nutritious. The small quantity of maltose which it is supposed to contain or the equally valuable glucose which it usually does contain, and the diastase may better be introduced as such, if a genuine indication for either exists. Beer is especially likely to cause gastric fermentation, while the stronger alcoholics are more likely to produce direct irritation and inflammation of the epithelium of the stomach and liver. The latter may act as appetizers and may even produce a genuine, though transient, stimulation of secretion, but as soon as alcohol reaches the proportion of 2 per cent in stomach contents, peptonization begins to be impaired. Thus, locally and transiently, the malt liquors are more likely to do harm, while remotely and permanently the vinous and spiritous liquors are worse. Beer is not a true galactagogue, as it was formerly considered, though it may increase the bulk of the mammary secretion.

Beers contain from 1.5 to 5 per cent of alcohol, some dextrin and maltose or glucose and a trifling amount of proteid. Porters and mild ales contain about 6 per cent of alcohol, Scotch ale 9 per cent. In general, the greater the alcoholic strength, the less carbohydrate remains.

WINES.

Champagnes are wines bottled while still fermenting, so that they are charged with CO_2. Red wines are prepared from the whole grape, white wines from the pulp alone. All grape wines contain tartrates and tartaric acid. A variable proportion of glucose—dextrose and levulose—persists in the sweet wines but has been almost or quite removed from those known as dry. Sparkling wines contain some CO_2 but less than champagnes. The various wines contain variable amounts of alcohol: cider, about 3.5 to 7.5 per cent., though sometimes much more, claret about the same amount, Sauterne, Rhine, Moselle Austrian, Greek, Hungarian, Italian and most American wines less than 12 per cent., sherry, port, Madeira and other heavy wines, 14 to 17 per cent.

DISTILLED LIQUORS.

Of the distilled liquors, brandy is prepared from wine to which burned sugar is added, whisky from wheat, rye, barley or corn; rum from molasses. Gin is practically a whisky flavored with juniper and, therefore a stimulant diuretic. Apple jack is an apple brandy. Liqueurs are diluted, sweetened and flavored spirits. All of the stronger spirits contain approximately 50 per cent of alcohol. The spirituous liquors contain various higher alcohols and compound ethers, amylic alcohol or fusel oil, being especially dangerous. It is reduced by "mellowing" so that the newer and rawer spirits are more toxic than those of some age. So far as immediate effects are concerned, the distilled liquors represent more nearly the effects of dilute alcohol than do the malt liquors and wines.

TEA, COFFEE, CHOCOLATE.

Tea and coffee differ, except in flavor, mainly in their relative contents of tannin and caffeine, the former excelling in tannin, the latter in the alkaloid. But both tea and coffee are injurious, both as astringents and as stimulants. Neither contains enough nutriment of any kind to deserve serious consideration. In addition to their local and general physiologic action, the precipitation of starch and proteids by tannin opposes the ordinary processes of digestion and is of nutritional importance. Chocolate, as already stated, is commonly employed in such form as to be genuinely nutritious and its alkaloid, though closely analogous to caffeine, seems to be less harmful. There are certainly many emergencies of life in which a cerebral and cardiac stimulant is indicated and these beverages fulfil the indication excellently. For routine use, we should urge persons under our observation to drink these beverages as weak as possible. The proteids of milk precipitate both the tannin and the alkaloid, and the small amount of either tea, coffee or chocolate necessary to flavor milk or milk and water may be taken with impunity. So weak beverages will, at first, be viewed with contempt, but they will soon become preferable to the strong. A mixture of coffee and chocolate may be acceptable to some palates.

CHAPTER IX.

CONDITIONS OF DIET AND DIGESTION.

ARRANGEMENT OF MEALS.

While the lower animals and the savages are compelled to the greatest irregularity in the time and amount of their feedings, the necessity of supplying nutriment to the body with a fair degree of regularity is too obvious to require discussion. As the average adult requires eight hours of sleep and as the common arrangement of work requires that this period of rest shall be unbroken, the minimum allowance of time for dressing and undressing leaves a day of fifteen hours within which all food must be taken. While some few persons exist on one meal a day, this custom imposes upon the storage and stoking powers of the body, a task for which they are inadequate (see Chapter II). With food of average bulk, it also overtaxes the capacity of the stomach. The time required for digestion of proteids and for the passage of food through the stomach on the other hand allows no time for physiologic rest of the stomach, if more than three meals a day are taken. Thus, from purely a priori considerations, it is obvious that the food should ordinarily be taken in two or three meals. Young and active adults, especially, feel the need of three meals daily, but for persons of advanced life and sedentary habits there is no objection to reducing the meals to two. For persons engaged in manual labor in the open air, rising early and going to bed early, it is plain that the first two meals should be "hearty," and the evening meal light. Persons engaged in professional or clerical work rarely are able to eat much at breakfast, and, partly as a matter of convenience and inaccessibility of their home, partly because the evening affords the only time of leisure, it is better that the principal meal should be taken at the close of the day's work.

While this consideration of meals has been confined to the needs of adults in health, it may not be out of place to call attention to the absurdity of feeding invalids at hourly intervals, of instituting a schedule of thirteen meals a day—as has been done by those who should know better—for patients with delayed gastric peristalsis, and of administering at bed-time hearty meals which necessitate active innervation of the digestive organs and which will inevitably cause renal elimination of such amount and kind that the rest must be broken to void urine, or, at any rate, that undesirable genito-urinary reflexes will occur. Under ordinary conditions, the mere bulk of urinary excretion is such that the bladder must be emptied after eight hours accumulation, to prevent too great distention. Largely as a matter of voluntary education we habitually train the inhibitory centers to prevent the emptying of the bladder at night. From the close anatomic relation of the inhibitory centers for the bladder and the lower bowel, it may very well be that the inhibition extends to the bowel, as well as to the neck of the bladder, and that this is one of the factors in producing chronic constipation. Persons whose evenings are unduly lengthened after the usual dinner or supper hour and who are kept awake by hunger or a sense of emptiness or actual gnawing in the stomach, may, however, take a light luncheon of bread and butter or crackers before going to bed.

DURATION OF DIGESTION.

Barring constipation and diarrhea, the total duration of digestion is from twenty-four to forty-eight hours. In other words, the indigestible residue of food taken at breakfast and, perhaps, at luncheon of one day will appear in the passages of both of the next two days, while food taken at supper or evening dinner of one day, will not be evident in the passage of the next day, unless this occurs late in the day, but the entire residue will be found in the stool of the second day. Probably, under ordinary conditions, the digestive process proper is entirely finished within twenty-four hours and the residue has reached the large intestine within twelve or fifteen hours.

The earlier and some of the more recent investigators have devoted much attention to the duration of gastric digestion and have compiled detailed tables of the time required for various foods to pass through the stomach. F. Schiling, a digestive specialist of Leipzig, has gone quite minutely into this topic in his Verdaulichkeit der Nahrungs und Genussmittel, published in Leipzig in 1901. Following Leube and Penzoldt, he had added his own observations, dividing test meals into four classes, the number of the class plus one, indicating the hour during which the meal would be expected to leave the stomach. In the first class, we have 250 c.c. or less of broth, boiled milk, smaller quantities of raw milk, 1 to 2 eggs, raw or soft boiled, 6 cakes (meaning English sweetened biscuit). In the second class are: 100 grams of boiled calf's brain, thymus, squab or chicken, freed from indigestible tissues, the same amount of raw ham eaten with "cakes," or 30 grams of tapioca with milk. In the third class are included roast squab and chicken, rare beef steak, raw shaved ham with white bread, 100 grams of each meat, or 50 grams each of bread, potatoes or cauliflower. In the fourth class are included: venison, partridge, roast beef, filet, veal, pike, 100 grams of each, or 50 grams of rice, stewed asparagus, or jam, without scales or seeds. It is difficult to reconcile these statements with clinical results in America, for it supposes that, for each class, only one viand is to be used at a test. Certainly a "jam" without seeds would, under ordinary circumstances, disappear from the stomach very soon after the end of the first hour.

From investigations with the tube in America, it may be stated that the simplest meal of broth will not ordinarily leave the stomach within much less than an hour; that a meal consisting of about 50 grams of some fine bread stuff, such as white bread, crackers or roll and 250 c.c. of water or some weak beverage not containing much milk, will be represented by only 20 to 50 c.c. at the end of an hour, and will have passed entirely into the intestine, or will have been absorbed, in about an hour and a half; that an ordinary mixed breakfast or luncheon will require 3 to 5 hours and a full dinner of soup, fish, hot meat, two or three vegetables, dessert, cheese, beverage and a salad, pickles, olives, etc., will require six hours, while a banquet of seven or eight courses will scarcely have left the stomach in eight hours.

Fine, gritty or scaly particles may adhere to the stomach wall from one meal to the next while large, tough masses or fruit pits may be retained much longer, as the pylorus tends to contract, when they are brought in contact with it. In general, the duration of gastric digestion has comparatively little dependence upon the chemic digestibility of foods in the stomach but rather upon the complexity of the food and its state of softness or susceptibility to maceration in the stomach.

COOKING OF FOOD.

The earliest archeological findings indicate the use of fire in the preparation of food, though certain foods, even including animals proteids, have been and still are habitually used in the raw state. While we have recently learned to recognize the advantage of cooking as a means of disinfection, its use antedates even the empiric recognition of fire as a deodorant and purifying medium and is doubtless to be ascribed to the desire to bring out the flavor of meats and to add that of empyreumatic oils produced during combustion, as well as to diminish the toughness of fibrous structures, animal or vegetable.

The terminology of cooking is largely arbitrary so that an essentially identical process may be known by different names or, conversely, in translating from one language to another, or in transposing the language of one cook to that of another of a different century or place, one may encounter various confusions of terms. For example, *roasting* was formerly applied to cooking before an open fire but now is understood to refer to cooking in an oven. In German, it is not usually possible to distinguish between *roasting, broiling* and *toasting,* except by the context. The terms of cookery are also used by arbitrary association as, for example, one rarely hears the word *scintilla* except in connection with *evidence,* Thus we have *toasted* and *baked* bread stuffs but *broiled* and *roasted* meats, the word *baked* also being applied to fish and similar viands which are not especially juicy.

It would be impossible, in a work of brief scope, to consider in detail the various culinary methods. There is a very general prejudice against fried, recooked and hashed viands. Provided that frying is done with an abundance of fresh fat, at a temperature sufficient to cause immediate coagulation at the periphery of the viand and that hashed and warmed up articles are not tainted and are otherwise of good quality, there is no particular objection to any of these modes of cooking for persons in health. For persons of weak digestion, including fever patients, elaborate cookery of all kinds and complexity of meals should be avoided and the preferable methods of cooking are broiling or toasting, roasting and baking.

CHAPTER X.

DIETETICS OF THE PERIOD OF GROWTH.

The prime considerations upon which we must base the dietary of childhood are (1) the need of forming new tissue, involving a relative excess both of proteids and of fats, the latter being deposited *pari passu* with the formation of functionally active tissues.

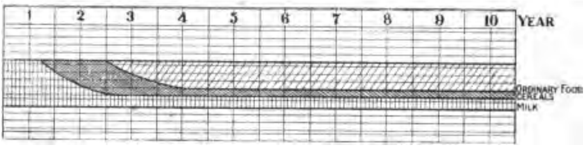
(2) The limitations of digestive power, especially during early infancy, this phase of the subject being conspicuous by its absence in later, healthy childhood.

(3) The inadvisability of employing any artificial spurs to appetite or digestive glands, so long as ordinary health is maintained.

(4) The relatively slight resistance at puberty and, in fact, throughout infancy, childhood and adolescence, especially at critical periods, against bacterial invasion and the effects of toxins.

The period of growth may be divided into early and late infancy, early and late prepubertal childhood, puberty and adolescence. Early infancy may be limited by the eruption of the incisors and the establishment of salivary and, suppositiously, pancreatic digestion of starches. Approximately, the sixth month may be taken as the end of this period. Late infancy lasts till the deciduous incisors are fairly complete, the child is able to be weaned and he begins to take active exercise by creeping and walking. The end of this period is from the twelfth to the eighteenth month. Early childhood may be limited by the appearance of a fairly full set of permanent teeth, excepting canines and posterior molars, and by the attainment of a more substantial figure and general health and resistance, at about the tenth year.

Late prepubertal childhood has its obvious limit in comparative sexual development Puberty includes a period of two or three years until the sexual functions are no longer a source of nervous disturbance and the general resistance has again reached par. Adolescence extends to the full development of the skeleton, the completion of dentition—except that the third molars are often delayed well into adult life or remain in the embryonic state—and the fairly perfect development of the beard in men and the breasts in women. Following this, there is a period of early adult life characterized by more or less intellectual immaturity, by deficient or excessive deposit of fat and, often, by a recrudescence of skeletal growth



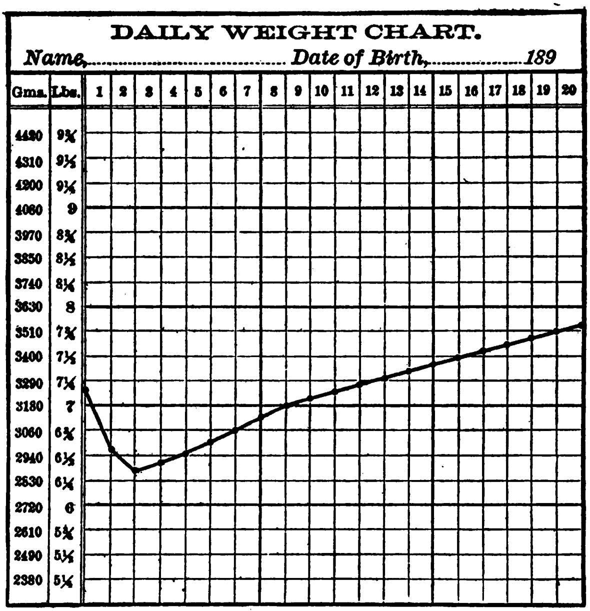
SHOWING STAPLE FOODS OF CHILD.

The accompanying diagram indicates crudely the staple foods of the child up to the tenth year. After this time, the dietary is essentially the same as for adults, except that condiments, tea, coffee, etc., and the various worthless or injurious articles in common use should be eschewed.

RATION REQUIRED AT DIFFERENT AGES.

It might appear easy to compute the ration of different ages in terms of the various organic foods, but this has not yet been satisfactorily accomplished, except to a certain degree for infancy. During infancy, there is comparatively little loss of energy by heat radiation or by exercise. During most of childhood, there is relatively an excess of exercise and oxidation. The excretion of volatile substances during early life is markedly less than during adult life. It is also noteworthy that different children show marked variation in the times at which they develop most rapidly. The accompanying charts and tables are, however, of interest in this connection. Ueffelmann, Hasse and others have estimated the albumin per kilogram required at various ages as follows:

Two Years.
4 Grams for an average weight of 12.5 kilograms.
Three to Five Years.
3.5 Grams for an average weight of 15 kilograms.
Eight to Eleven Years.
2.5 Grams for an average weight of 24 kilograms.
Adult.
1.5 Grams for an average weight of 65 kilograms.

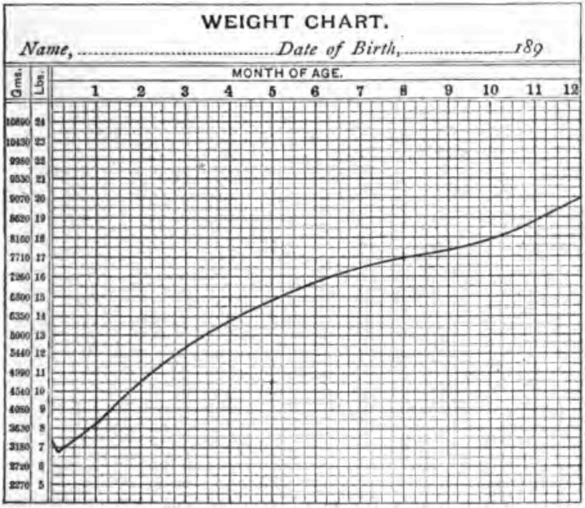


L. Emmet Holt WEIGHT BY YEARS.

Boys.				Age.	Girls.			
Height.		Weight.			Height.		Weight.	
Centimetres.	Inches.	Kilogrammes.	Pounds.		Centimetres.	Inches.	Kilogrammes.	Pounds.
49.37	19.75	3.25	7.15	Birth.	48.12	19 25	3 15	6.93
61.87	24.75	6.50	14.30	5 months.	59.12	23.25	6.30	13 86
73.82	29.53	9.54	20.98	1 year.	74.17	29.67	9 00	19.80
84.55	33.82	13.80	30.36	2 years.	82.35	32.94	13.31	29.28
92.65	37.06	15.90	34.98	3 years.	90.77	36.31	15.07	33.15
98.27	39.31	17.27	37 99	4 years.	97.00	38 80	16 53	36 36
103.92	41.57	18 64	41.00	5 years.	103.22	41.29	17 99	39.57
109.37	43.75	20.49	45.07	6 years.	108.37	43.35	19 63	43.18
114.35	45.74	22.26	48.97	7 years.	113.80	45.52	21.50	47.30
119.40	47.76	24.46	53.81	8 years.	118.95	47.58	23.44	51.56
124.22	49 69	26.87	59.00	9 years.	123 42	49.37	25.91	57.00
129.20	51.68	29.62	65 16	10 years.	128.35	51.34	28.29	62.23
133.32	53.33	31.84	70.04	11 years.	133.55	53.42	31.28	68.70
137.77	55 11	34.89	76.75	12 years.	139.70	55.88	35.53	78.16
143 02	57.21	38.49	84.67	13 years.	145.40	58.16	40.21	88.46
149.70	59.88	42.95	94.49	14 years.	149.85	59 94	44.65	98.23

Rotch (see also Heinrich Stern's Table in a following chapter).

Thus the amount of albumin needed per kilogram of body weight decreases as the body develops. In an approximate degree, the fat ratio follows that for albumin, while the carbohydrate ratio increases, subject to variation in proportion to exercise and oxidation and also in accordance with the power of the individual organism to digest and assimilate fats.



L. Emmet Holt

The following indicates the amounts of organic foods required at different ages up to puberty, according to Schroeder:

Age	Grams Proteid	Grams Fat	Grams Carboh.
1½	42.5	35	100
2	45.5	36	110
3	50	38	120
4	53	41.5	135
5	56	43	145
8-9	60	44	150
12-13	72	47	245
14-15	79	48	270

FACTORS USED IN CALCULATING MEALS CONSUMED IN DIETARY STUDIES.

(Atwater, Report of U. S. Dept. of Agriculture.)

One meal of woman equivalent to 0.8 meal of man at moderate muscular labor.

One meal of boy 14 to 16 years of age, inclusive, equivalent to 0.8 meal of man.

One meal of girl 14 to 16 years of age, inclusive, equivalent to 0.7 meal of man.

One meal of child 10 to 13 years of age, inclusive, equivalent to 0.6 meal of man.

One meal of child 6 to 9 years of age, inclusive, equivalent to 0.5 meal of man.

One meal of child 2 to 5 years of age, inclusive, equivalent to 0.4 meal of man.

One meal of child under 2 years of age equivalent to 0.3 meal of man.

These factors are based in part upon experimental data and in part upon arbitrary assumptions. They are subject to revision when experimental evidence shall warrant more definite conclusions.

The limitations of digestive power during the period of development are mechanic and chemic, the former referring especially to dentition. The normal average of dental development is as follows:

DECIDUOUS TEETH.

Lower central incisors, 6-9 month.

Upper central and lateral incisors, 8-10 month.

Lower lateral incisors and first molars (corresponding to first bicuspids), 15-21 month.

Canines, 16-20 month.

Second molars (corresponding to second bicuspids), 20-30 month.

PERMANENT TEETH.

First molars, 6 year.

Central incisors, 7 year.

Lateral incisors, 8 year.

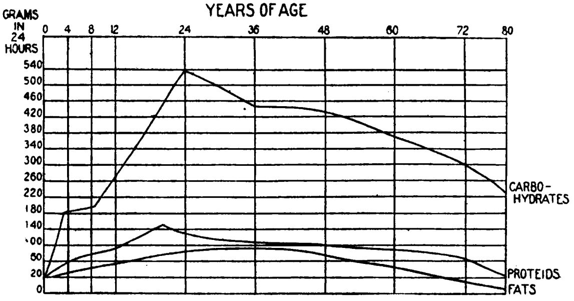
First bicuspids, 10 year.

Second bicuspids, 11 year.

Canines, 12-13 year.

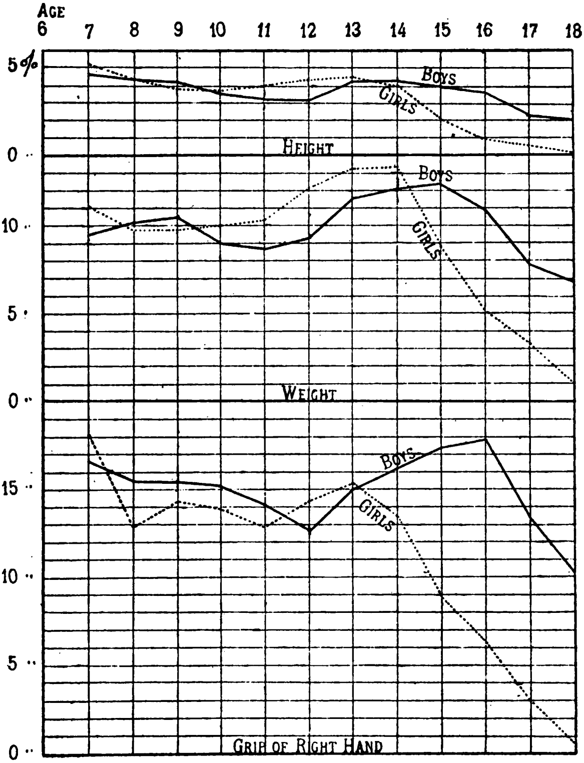
Second molars, 12-15 year.

Third molars, 17-21 year.



FOSTER'S CHART OF FOOD NEEDED AT DIFFERENT AGES.

In general, in both sets, the lower teeth appear before the upper. The order of appearance is, however, very variable. A glance at this table shows that while the young infant has incisors whose value is impaired by the lack of molars,



Christopher

ANNUAL INCREASE IN WEIGHT, HEIGHT, STRENGTH OF GRIP.

there is a period of varying length between the fourth and seventh years, during which the child is liable to be deficient in incisors, while well equipped for grinding his food. It is largely on this account that cereals are not adapted to the use of the young infant, while they are especially adapted to the needs of early childhood.

Owing to the extensive curves of the sigmoid and the small size of the pelvis in the infant, he derives comparatively little benefit from the auxiliary muscles of defecation and must depend largely on peristalsis so that a bulky fecal mass is not desirable. On the other hand, as the abdomen becomes more capacious, defecation depends more and more on the expulsive power of the abdominal muscles, and a cereal diet becomes well adapted to the free action of the bowels. Any alteration of dentition by rhachitis, caries, etc., demands corresponding provision in the diet. It is a great mistake to neglect the cleaning of the deciduous teeth simply because they are temporary, not only because carious deciduous teeth are likely to infect the permanent teeth, but because it is important that the nutrition of the child should progress normally.

DIET IN INFANCY.

The chemic digestion of early infancy is almost entirely limited to the peptonization of proteid by trypsin—there being at this time very little or no secretion of hydrochloric acid and, consequently, little peptic action in the stomach, the splitting of fats by steapsin and their subsequent emulsification, saponification and absorption, and the splitting of lactose by invertin of the intestine into dextrose and galactose. E. Garte (Bolnitchnaia Gazeta Botkina, Vol. XII, No. 1) by extracting the pancreas of fetuses and still-born infants, has found that all the ferments are secreated after the third month of intrauterine life, but that amylopsin in the new-born is present in only a quarter of its strength in the adult. Besides the relative deficiency of bile in excretory products, it is deficient in its useful constituents, sodium taurocholate and glycocholate, whose normal function is to aid the osmosis of fats. Thus, the infant loses a considerable portion of the fat ingested in milk, though the activity of the lymphatic system is somewhat compensatory as there is a relative excess of leucocytes which aid in the conveyance of fat through the intestinal wall. The lack of HCl is of importance, not so much because of the abeyance of gastric digestion, which is never so thorough as that of the pancreas, as from the impairment of its important antiseptic action. This action, though slight from the standpoint of the bacteriologist, when we consider the normal dilution of HCl in the stomach, is of the utmost practical value. The infant begins life with a sterile alimentary canal and its normal food is sterile. The indication to protect it from the introduction of bacteria, when artificially nourished and from accidental sources of infection, such as filthy nipples when naturally fed, is obvious.

There are singularly few accurate observations to determine the time at which ptyalin, pepsin, HCl, and amylopsin begin to be secreted, but gastric digestion, including the salivary digestion of cooked starch, is fairly well established during the second year, while amylopsin is present in fair amount at some time during later infancy, so that, after the sixth month, there is a probability that starches may be digested, but they must be given cautiously, according to actual demonstration of the condition of the feces and, under normal conditions, they need not be given at all till it is time to wean.

MOTHERS' MILK AND ITS SUBSTITUTES.

It would be a waste of time to argue as to the general preferability of mothers' milk over all possible substitutes during the first year of life. Yet, purely from the standpoint of the child's welfare, nursing should not be continued if the mother develops an acute febrile disease, if she has any disease of any excretory organ—not forgetting the liver—which causes a notable increase of waste products in her blood; if she has any infectious disease liable to be communicated through the milk, or if there is any local mammary or constitutional disease which vitiates the quality of the milk. Fortunately, acute febrile diseases usually produce a prompt suspension of lactation. There is no disease of the skin or lungs which need be considered merely from the standpoint of the accumulation of normal waste matter in the blood. Renal disease, excepting of the mildest degree or of purely mechanic nature, such as movable kidney and calculus, without suppuration, is usually an absolute contraindication to nursing. Hepatic disease need not be considered unless well advanced or unless of infectious nature.

Practically all systemic infections of the mother contraindicate nursing, either on account of the danger of introducing bacteria or their toxins, except syphilis, when the child is already infected. This disease does not seem to be exacerbated by the further introduction of its living cause, but the same argument does not apply to tuberculosis. Even acute psychic disturbances of the mother may produce toxic and even lethal qualities of the milk and a temporary intermission of nursing should be ordered as a matter of routine warning in advance of the occurrence of great anger, grief or other excitement of the mother. Constipation, moderate digestive disturbances, insomnia, moderate anemia and loss of physical strength, are not so much contraindications to nursing as indications to improve the health of the mother in the interests of the child. Lactation may safely be continued during the first three or four months of a successive, normal pregnancy or after menstruation has been reëstablished, unless the milk becomes scanty or bloody or is found empirically not to be wholesome. Any severe constitutional derangement of the mother should interdict nursing in the interests of both parties.

Nature has ordained that all of us should begin life with a fast of two or three days. In order to stimulate the secretion of milk and to educate the child in sucking, it should be put to the breast at regular intervals, even before the mammary secretion is formed, and it will derive at least laxative benefit from colostrum. Boiled water may also be given to quench thirst and assist excretion, but the old custom of giving milk, herb teas or sugar and water is to be condemned.

So long as a baby is nourished in the normal way, we have little opportunity to control the exact amount of nutriment or even to know how much is taken, except by weighing before and after nursing, on delicate balances. The sufficiency of nourishment must be judged by the weekly gain, comparing with the table already presented.

FREQUENCY OF NURSING.

Nature has, however, provided a measure accurate enough for practical purposes, and we may say that the infant should have a "stomachful" of milk every 2—2½ hours, excepting one or two feedings at night, unless, again, the child is restless and cries for its regular feeding. It should be impressed most emphatically upon the mother that milk is not secreted to put the child to sleep, to stop its crying, to quench thirst, nor to afford amusement, and that the nipple is not meant to cut teeth upon, in short, that the sole function of the breasts is to furnish food. The nursing time of a baby is its meal, and it is even more important for the infant than for the adult to have its meals regularly. Mothers should also be taught that while the only language of the baby is a cry, it expresses several very distinct ideas by different tones and inflexions, and it has many other discomforts than hunger. It may be thirsty, too cold, more often too warm, its clothes may be too tight, it may itch from flannel garments, a soiled diaper, poor soap, insects, etc., or a pin may be pricking it. Even a strong light may hurt its eyes or various sounds or odors may be disagreeable. Theoretically, a baby needs no water except that contained in milk; practically, it is wise to administer a little boiled and cooled water several times a day, between feedings.

If regularly nursed and properly cared for in other ways, the baby may usually be trusted to take a "stomachful" at each feeding. If it draws more, it pukes, or, in other words, spills over, and, on account of the relatively small size and strong walls of its stomach, no harm is done, puking being very different from vomiting of adults. The capacity of the stomach is as follows:

	Cotton.	Rotch.
Premature, 8 months......	...	8 c.c.
At birth	32	...
Five days................	...	25—30
End of 1 month..........	75	75
Eight weeks..............	...	96
End of 2 months..........	105	...
End of 3 months..........	132	...
Sixteen weeks............	...	107
End of 4 months..........	145	...
Twenty weeks.............	...	108
End of 5 months..........	155	...
End of 12 months.........	250	...

Beneke states that the capacity of the stomach at 2 years is 350 c.c. and at 12 years 740 c.c. Allen estimates the capacity of the adult stomach at 2000 c.c.; Henle and others at 2500 c.c.

As the size of the stomach increases at a greater rate than the body as a whole, the frequency of nursing may be gradually reduced. For the first six weeks, the interval should be 2—2½ hours, skipping once at night. After three or four months, the interval should be three hours, and, in some cases, the interval may be lengthened while, usually, two feedings may be skipped at night. By the time of weaning, at the end of the first year, the child will have been for a couple of months on a schedule of meals at 3—4 hour intervals with an interval of ten or twelve hours at night. Nursing should ordinarily occupy about 15—20 minutes. In case of cleft palate, tongue-tie, etc., a little longer may be needed.

During lactation, the child is best medicated through the milk or by inunctions. If it becomes necessary to medicate the mother on her own account, it should be remembered that alkaloids, including, of course, all drugs that contain them, mercury, iodine and aromatic ring compounds are likely to affect the child dangerously. Otherwise, there is little contraindication to medicating a nursing woman.

When the baby cannot suck or when some other purely mechanic obstacle to nursing exists, the milk may be pumped from the breast and fed by a spoon or medicine dropper, in amount corresponding to the size of the stomach.

WET NURSING.

Theoretically, the best substitute for mother's milk is that of some other woman. In a simple social state including that of our own lower (?) classes, women have an abundance of sisters, sisters-in-law and other intimate friends, while pregnancy and lactation are so common occurrences that it is often easy to find a foster mother; indeed, temporary exchanges of lacteal courtesies are not rare, merely as a matter of mutual convenience. In the "better" classes, pregnancies are less common, so that there are fewer available near relatives and the chances of any one of these having functionally active mammary glands are extremely small. Thus, wet nurses must be hired and, aside from the obvious item of expense, difficulties of the utmost practical importance present themselves.

It is commonly asserted that the wet nurse should be of about the same age as the mother and about as far advanced in lactation. If the constitution of milk changes progressively, the latter contention is sound, but there is considerable doubt regarding this point and, in either case, it is not of prime importance. There is no obvious reason why, if the child must have a foster mother, she should not be of the optimum age, about 25, without reference to the age of the mother. The finding of a wet nurse is practically always an emergent matter. To decide on short notice that neither the baby nor the volunteer foster mother is syphilitic or otherwise dangerous to the other party, that the nurse is free from the various factors that predispose to poor or insufficient milk, that she will be careful of her own diet when placed suddenly in the midst of unaccustomed plenty and variety, that she will not take liquor or other drugs, that she will nurse the baby regularly, that she will not keep it quiet with soothing syrups, or by masturbating it or otherwise misuse her responsibility—all this is a difficult matter to decide offhand.

CHAPTER XI.

DIETETICS OF THE PERIOD OF GROWTH (Cont'd).

ARTIFICIAL SUBSTITUTES FOR HUMAN MILK.

The only generally available and, all things considered, the best animal milk for our purpose, is that of the cow. Comparing Leed's analysis of average human and bovine milk:

	Cows Milk.	Human Milk.
Reaction	feebly acid.	persistently alkaline.
Specific gravity.	1029.7	1031.3
Bacteria, always	present in	absent.
	Dairy Milk.	
Fats	3.75%	4.13%
Lactose	4.42	7.
Proteids	3.76	2.
Ash	.68	.2
Total solids	12.61	13.33

it is obvious that the former contains too little fat and lactose and too much proteid and salines. The last item, however, as well as the difference in specific gravity, reaction and proportion of water, is insignificant. Of greater importance than the comparatively small differences in percentage composition are the practical impossibility of securing sterile cows' milk, and especially the danger of its containing specific bacteria—tuberculosis being of paramount importance—and the fact that its proteids and fats are not quite the same as those of human milk, so that the curds formed are larger and denser and less digestible. The differences in percentage composition may be remedied by centrifugal separation, analysis and recombination of milk or, approximately, by the empiric use of milk, cream and water, as will be directed later. We need not trouble ourselves as to the chemic differences of fats and proteids, as they are entirely beyond our present abilities. The size of the curds may be lessened by dilution with plain water, gluten water or lime water. The same process of dilution enables us to diminish the proteids, fats and lactose, the last two proportionately too much, so that cream and sugar of milk must be added. The latter is stable and may be conveniently prescribed in powders of requisite size. When suitable laboratories are available, milk of any desired percentage composition may be prescribed. For the home modification of cows' milk, we must assume that the milk and cream are of average composition and must recombine according to algebraic computation. Various graduates, small dippers, etc., are on the market, with rules for combining milk, cream and diluent to prepare the proper food for infants of various ages. On the whole, one may just about as easily combine according to tablespoonfuls. There are so many irremediable obstacles to ideal results that slight centesimal errors may be ignored.

The use of one cow's milk is largely a notion, though one cow can be watched more carefully than a herd. The use of mixed milk averages the danger of infection but, also, averages the constituents of the milk.

By weighing babies before and after nursing, L. Emmett Holt has established the ration for normal infants on mothers' milk, as follows:

Age.	Number of feedings.	Ounces at a feeding.
Two weeks......	8	2
One month.....	8	3
Two months.....	7	4
Four months....	6	5
Six months.....	6	5½—6
Nine months....	5	7—7½
Twelve months..	5	8—9

I leave the amounts in ounces as the figures multiplied by two are then readily converted into tablespoonfuls. A few prescriptions for substitute feeding are appended, beginning with a table published by the Walker-Gordon Laboratory Co.:

"The table below shows the average percentages employed by 117 physicians for the feeding of 224 healthy infants.

"The percentages are given in the round numbers next nearest the actual percentages employed, and are approximate.

(Table following Holt, Rotch's data and amounts correspond very closely.)

THEORETIC BASIS FOR FEEDING A HEALTHY INFANT.

		Per Ct. Fat	Per Ct. Milk Sugar.	Per Ct Proteids.
Premature infant.......	Drams — 2-6	1.00	3.00	0.20
		1.00	4.00	0.50
		1.50	4.50	0.75

	Hrs.	Oz.	
Birth at term	24-36	1	5 per cent Solution Milk Sugar, Distilled Water.

Age.	Oz. Gastric Cap'ty.	Fat.	Milk Sugar.	Proteids.
1st Week.......	1	2.00	5.00	0.75
2d "	1½	2.50	6.00	1.00
3d "	2	3.00	6.00	1.00
4th to 6th......	2½—3	3.50	6.50	1.00
6th to 8th......	3 —3¼	3.50	6.50	1.50
8th to 16th.....	3¼—4½	4.00	7.00	1.50
16th to 24th....	4½—5¾	4.00	7.00	2.00
24th to 32d.....	5¾—7	4.00	7.00	2.00
32d to 36th.....	7	4.00	7.00	2.25
36th to 40th....	7 —8	4.00	6.50	2.50
40th to 44th....	8 —8½	4.00	5.00	3.00
44th to 48th....	8½	4.00	4.50	3.50
48th to 52d.....	9	4.00	4.50	4.00

Note.—The percentages given above may be considered slightly high for the average, as they represent only the modifications employed for perfectly healthy infants."

PREPARATIONS FROM COW'S MILK.

Thompson, quoting Leed's statement that the curds of cows' milk are five times as bulky as those of human milk, and Escherich's advice to dilute milk with two parts of water, advises using the upper fifth of a quart of milk, after standing; diluting with two parts of water and adding a heaping teaspoonful of milk sugar to every four ounces of this diluted "top milk" or weak cream. Holt suggests the use of equal parts of ordinary cream (containing about 25 per cent of butter fat) and fresh milk instead of the top milk after standing. Holt, who believes in the use of glutinous diluents, also recommends, for the first seven or eight months, a mixture in the proportion of a half pint of top milk (or his substitute just mentioned), a pint of barley water and six heaping teaspoonfuls of milk sugar. This amount is adequate for the second month, there being a little waste earlier. Later, the quantity must be increased. After the seventh or eighth month, the formula is changed to:

Top milk, 38 tablespoonfuls.
Barley water, 38 tablespoonfuls.
Milk sugar, 9 teaspoonfuls.

Holt and Rotch, for practical purposes, do not follow the table of capacities of the infant stomach, but advise the total quantity of food, as follows:

Age.	Meals.	Total Quantity for 24 Hours.
1 week.....	10	10 ounces.
2—3 weeks..	10	15
4 weeks.....	9	20
6 weeks.....	8	24
3 months...	7	28
5 months...	6	33
6 months...	6	36
9 months...	5	37.5
12 months..	5	40

Lewis Smith states that the average daily nourishment for an infant under four weeks of age is 400 c.c. of milk and, from the second to the eleventh month, 720 c.c.—a considerably lower estimate than those of Holt and Rotch. Biedert states that a child of one month, weighing six or seven pounds, required 175 to 200 c.c. of cow's milk and, during the second month, the weight being 8 pounds, 300 to 720 c.c. He also lays down the rule that the daily milk ration of an infant should be 10 per cent of its weight.

Henry L. Coit gives two methods of obtaining cream containing 10 per cent of fat.

℞ Top 6 ounces from 1 quart milk after 15 hours. Water, 3 ounces.

℞ Top 11 ounces from 1 quart milk after 15 hours.

ALGEBRAIC COMPUTATION OF PERCENTAGE MILK.

Prof. Mary M. Wardwell of the Buffalo Central High School has kindly assisted in preparing formulas for the alligation of milk, cream and water to form a milk substitute of desired constitution of fat and proteid. Obviously, the fat and proteid must lie within the limits in which they occur in the cream and milk. If these maxima and minima are passed, the solution of the equations will give negative values for certain of the ingredients. Manifestly, also, we cannot mix water, cream and milk so as to get desired proportions of proteid, fat and lactose, but only of two of these ingredients. However, we may combine to get a desired proportion of fat and proteid, estimate the lactose and add enough to bring the artificial milk up to our standard.

Our unknown quantities are:

x = number of units of milk.
y = number of units of cream.
w = number of units of water.

The known quantities are:

a = number of units of mixture prepared.

In the desired mixture, p, f and l, proportion of proteid, fat and lactose.

In milk, p', f', and l', proportion of proteid, fat and lactose.

In cream, p'', f'', and l'', proportion of proteid, fat and lactose.

We then have the equations:

$$p'x + p''y = pa$$
$$f'x + f''y = fa$$

Solving, $$x = \frac{a\,(pf'' - fp'')}{p'f'' - f'p''} \qquad y = \frac{a\,(fp' - f'p)}{p'f'' - f'p''}$$

the solution being conducted so as, for convenience, to bring the same denominator for both fractions.

$w = a - (x + y)$, if we do not consider the slight discrepancy due to the addition of a small amount of lactose, to be dissolved.

z, the number of units of lactose, is determined from the equation:

$$l'x + l''y + z = la.$$

If the gravimetric system is employed, as is necessary for mathematic accuracy, but not for practical purposes:

$$w = a - (x + y + z).$$

In average cows' milk, $p' = .0375$
$f' = .0375$
$l' = .0442$

In cream, $p'' = .027$
$f'' = .267$
$l'' = .028$

The desired standard is human milk, in which
$p = .02$
$f = .0413$
$l = .07$

From these data, we get $x = \dfrac{422.49}{900} a \quad y = \dfrac{79.875}{900} a$,

and it happens that it is convenient to make up 900 c.c. or fluid grams, which is nearly a quart, so that our mixture will be expressed in the form of a prescription as follows:

R	Milk	422.5
	Cream	80.
	Water ad.	900.

$z = la - (l'x + l''y) = 63 - (18.67 - 2.23) =$ 46.56 grams of lactose to be added. If preferred, the solution can be made for single feedings and translated for domestic use into any desirable units, and the necessary quantities of lactose are, in all cases, best ordered by prescription from the drug store. For practical purposes, the volumetric method is exact enough, indeed, the simple approximations already quoted of mixing milk, cream and water, are sufficient. In all cases I would suggest that it is well to use a six per mille saline solution in place of pure water or to add a pinch of salt to each feeding.

SUBSTITUTE FEEDING BY OTHER THAN MODIFIED MILK.

In order to avoid the assumption of responsibility, no reference will be made to proprietary infants' foods except in general terms. For home or institutional feeding, extemporized compounds of cows' milk are preferable. For traveling or whenever the milk supply is suspected of pathogenic or saprophytic infection, and sterilization is not convenient, one of the dry milk powders may be used.

Starchy foods should not be used till after the sixth month or until glycolysis is established by testing the saliva and ascertaining that there is no notable loss of starch in the stools. Foods containing maltose, lactose or glucose in proper proportion with proteid and fat, or even moderate quantities of dextrin but no carbohydrate which will give a blue or purple with iodin, are allowable, and some few may be stirred up with water to make a very passable substitute for human milk. Meat juice and extracts which still contain albumen or albumose, and are not merely excrementitious, as well as white of egg in water, may be used occasionally, especially in fevers.

Holt's table of milk necessary in 24 hours may be converted into cubic centimeters by multiplying the number of ounces by 30 or 32. According to Leed's table, already given, the fats, lactose and proteids in average human milk are, respectively, 4.13, 7 and 2 per cent. Thus, to determine from Holt's table the amount of any one organic ingredient needed at a given age, we multiply the number of ounces by 30 and this product by the respective per cent. In emergency feeding by white of egg or meat juice or extract, we have practically no carbohydrate nor fat. The fat may be ignored for a few days and the lactose may almost always be added in sufficient amount, or may be given subcutaneously. (See author's method of emergency feeding by injection under the skin, in a subsequent chapter.) The white of an egg weighs 27 grams and contains about 5.5 grams of proteid.

Thus, for a child in the first week one white of egg contains very nearly the full proteid ration for a day. Beef juice contains about 6 per cent of proteid and a minute amount of carbohydrate, with a very variable amount of fat. The various proprietary meat extracts are usually accompanied by analyses, but I am unable to vouch for their correctness and there is urgent need that there should be some reliable central board for the verification of all such claims. It is customary to add a drop or two of whisky or brandy to each feeding, but this often results in intoxication which is mistaken for febrile symptoms.

THE USE OF BUTTERMILK.

Buttermilk is occasionally acceptable as a food, both for infants and adults. Owing to the process of souring and removal of butter, it differs from sweet milk in containing somewhat less lactose, considerably less fat and, as it arises from cream in which the original excess of fat supplanted part of the other ingredients of milk, the proteids are also diminished while the caseinogen is represented by fine flakes of casein, the curds having been broken up by churning. B. Salge gives its average composition as follows: Albumin 2.5 per cent. (including casein), fat 0.5 to 1 per cent., lactose 3 to 3.5 per cent. The acidity is about 70 per cent., i. e., 100 c.c. of buttermilk just shows an end reaction with phenolphthalein when 70 c.c. of decinormal sodium hydrate solution is added. Wheat flour and cane sugar may be added to make good the deficiency in proteid and carbohydrate. Buttermilk should, of course, be from a reliable source and should be used within twenty-four hours. Cream that has been accumulated for several days for churning, should not be used as a source of buttermilk. While the saprophytes of buttermilk are usually incapable of disturbing the digestion of adults, it is well to sterilize by boiling before using as an infant's food.

STERILIZATION AND PASTEURIZATION.

The sterilization of milk or other food is accomplished by placing it in bottles stopped with absorbent cotton which has itself been sterilized by dry heat, in an oven, and the bottles are heated to boiling point for ten or twelve minutes. Pasteurization is partial sterilization at 160—170° F. The former will destroy any bacteria likely to be found in milk, while the latter will destroy almost all saprophytes and most tubercle bacilli. Sterilization destroys the amylolytic ferment present in milk—which may usually be dispensed with—it renders more difficult coagulation and digestion of casein and, of course, precipitates lactalbumin. If too long continued, it also destroys the lactose, but converts it into glucose sugars. The fat is also rendered less absorbable, probably because it coalesces instead of remaining in minute droplets. Pasteurization is less efficient to destroy micro-örganisms but has a less deleterious action in all these respects. In any case in which the milk is thus heated or in which artificial foods are employed for more than a few days, there is danger of scurvy, and half a teaspoonful of orange or pineapple juice should be given once or twice a day.

ASEPTIC PRECAUTIONS.

At all times the following precautions in asepsis should be observed: The child's lips, tongue and mouth should be kept decently clean, and the nipples should be washed before and after nursing. Borax water, followed by pure boiled water, is as good a wash as any for practical purposes. The food should be prepared fresh for each nursing. Short rubber nipples alone should be used and both bottle and nipple should be boiled before using. Milk, cream, etc., should be bought only in bottles filled at the time of milking, and should be kept on ice. Only boiled or distilled and hermetically sealed water should be used. The use of antiseptic chemicals is dangerous. In regard to sterilization and Pasteurization, a balance must be made between danger of non-specific or pathogenic infection and of malnutrition, the balance turning toward sterilization if there is reasonable danger of specific disease, such as tuberculosis, typhoid, scarlatina, etc.; toward Pasteurization if there is merely danger of saprophytes, as in hot weather and in the case of slum children. If the preparation of the milk must be left to ignorant attendants, it is usually better to use condensed milk or some proprietary food.

WEANING AT THE CLOSE OF NORMAL LACTATION.

What has been said regarding substitute feeding applies to weaning early in infancy. The ordinary nursing period is one year, though some tribes, including the ancient Jews, have nursed their children until the third or fourth year with good results. It is better to wean after or before the hot term; before if menstruation, subsequent pregnancy, condition of general health, etc., indicate that weaning cannot be postponed till fall. As early as the seventh or eighth month it is well occasionally to let the baby suck a piece of steak, salt pork or a bone. Weaning should begin by substituting for the breast, once or twice daily, a bottle of milk according to one of the formulas already given. Arrowroot, farina, other soft cereals, part of a soft boiled egg, beef juice, light soups, cracker or bread and milk are to be gradually added to the dietary. Weaning should be completed in not less than one nor more than two months, returning to exclusive breast feeding if any trouble arises. During this period, the feedings should be five daily, from seven to seven o'clock. M. Allen Starr suggests the following mixture, especially adapted to weaning at the tenth month:

Cream	1 tablespoonful
Milk	8 tablespoonfuls
Lactose	30 Grams
Water	3 tablespoonfuls

The daily ration at the end of the first year should not exceed 1500 c.c., and solid food should be added or the amount of water should be reduced if the child does not gain weight.

DIETETICS OF CHILDHOOD.

During the second year the number of meals should be reduced from five to four, at which number they should be held till the age of five or six. Throughout childhood and adolescence a light luncheon, in addition to the regular three meals, will often be advisable, its time and nature being determined by exercise, appetite and interval between regular meals. The single session of so many high schools, though an excellent institution for most reasons, is rather long when we include the average time for going and returning, and many pupils pass the time of hunger and become too faint to relish their midday meal. This trouble could be obviated by adjusting the schedule to four periods instead of five, or by allowing pupils to come one hour late or leave one hour before the end of school, according to the arrangement of their recitations.

During the second and third years the food should consist mainly of milk, eggs, cereals, enough meat to provide haemoglobin—the fibre being rejected—while soft, pulpy fruits, baked apple, custards, bread pudding, a little candy, etc., are allowed for dessert. Children, as a rule, do not digest meat fats well, but will naturally take enough cream, butter, etc., to make up the deficiency. The attempt to discipline a young child into eating yolk of eggs, gristle, fat meat, vegetables, etc., is both cruel and physiologically absurd, though reasonable persuasion to secure a proper variety is often necessary. The craving for cookies, candy, etc., is a physiologic appetite, as the child exercises considerably more than the average adult and is exposed to the cold in his play during the winter, so that fuel foods are needed. Eating at irregular intervals, should, however, be rigorously forbidden.

AVERAGE RATION IN CHILDHOOD.

M. Allen Starr has found the average ration of children to be as follows, judging from groups in which the normal appetite was measured and averaged:

	2-3 years (28 cases.)	3-6 years (12 cases.)	4-10 years (24 cases.)
Bread	7.5	10.3	10.23 oz.
Butter	.98	1.08	.99
Beef	4.6	12.1	12.46
Potatoes	3.9	Rice 13.	10.23
Milk	32.6	48.6	38.5

As the child grows older he will require less and less special attention to diet, but the food should always be plain, simply cooked, without condiments or relishes, and the meals should be regular with regard to interval, time at table and amount. The teeth should be carefully watched and, if necessary, filled rather than pulled. Teething, like menstruation, puberty, pregnancy and the menopause, is simply a physiologic crisis; it ought not to be regarded as a disease nor should it be made the excuse for neglect of ordinary care in diagnosis and treatment.

DIET IN THE SCHOOL PERIOD.

About the seventh year rapid physiologic growth and our artificial system of education often prove too much for the child's nutritive power and he undergoes a decadence of strength. Rest, especially out of doors, becomes necessary, and no amount of mere attention to diet can take its place. At the same time there is a good deal of affectation in the attack on the school. The average child is benefited by its discipline of mental application and really enjoys it. In many instances, especially in late childhood and adolescence, what is charged to strain at school is due to insufficient sleep, bad hygiene at home, work or social engagements not excessive in themselves, but which can no more be carried on in connection with study at school than, for example, in connection with medical practice by an adult. Eye strain, movable kidneys and various other organic defects may be at fault rather than the educational system. Again, children who are essentially deficient in mental or physical strength and who need special educational methods are expected to fulfill the requirements of a public school or the school is expected to reduce its requirements to fit the case of these defectives. Some parents, also, from poverty or indifference, leave to the teacher the duties of both parents and family physician.

So far as possible the lunch box should be ruled out of every one's routine, whether child or adult. During attendance at grammar school, at least in cities, it should be possible for every child to go home for dinner, which should be at least as hearty as the evening meal for children. This matter, in connection with high schools, has already been touched on. Even in colleges and professional schools it would be by no means undignified to arrange the schedule in accordance with dietetic hygiene.

The dietetics of puberty, including the periodic depression during the establishment of menstruation, requires no special scientific consideration, but merely a little motherly tact in coaxing the appetite as may be needed. The general contraindication to too much meat, stimulating beverages, condiments, etc., is particularly important at these periods on account of the effect on the nervous system and the reflex aphrodisiac influence of irritants of the central nervous system or of the urinary passages.

CHAPTER XII.

ORGANOTHERAPY.

The term *opotherapy,* recently introduced as a synonym for organotherapy, is not so expressive as the earlier term, as *opo* means a juice and especially a vegetable juice. As our pharmaceutic skill in preparing animal extracts becomes more and more perfect, we tend more and more toward the use of definite active principles, inorganic, organic or even ferments, so that it is impossible to exclude from this discussion such substances as pepsin and hydrochloric acid which have been in common use longer than certain unrefined extracts to which the term *organotherapy* is popularly limited. Indeed, in the broadest sense, we must include in this category any drug which supplies any needed tissue ingredient, such as iron or any secretory product.

"SIMILA SIMILIBUS" IN DIET.

The basis of organotherapy is the theory that the growth of an organ and its functional activity are best supported by the assimilation of corresponding organs. This argument may be carried to an absurd degree as in the caricature report of "tailine" which caused the renewed growth of a tail of a cat after amputation. It is ridiculous to suppose that one muscular part of an anmial would afford better nutrition for a given group of muscles than another. Yet it is at most a far-fetched idea and it may possibly be of benefit to administer heart to nourish heart, brain to nourish brain, blood to supply blood, etc., always provided that we do not defeat our ultimate object by exciting the disgust of the patient.

But the writer would not be understood as conceding his belief in the practical efficacy of such an assortment of food. In the case of an organ producing a useful secretion, the use of the corresponding extract will unquestionably favor the formation of the deficient secretion. On the other hand, in the case of an excretion like that of the kidney or liver—bile being mainly, though not entirely excrementitious—the use of the corresponding organ, its secretion or an extract, will usually throw additional work upon an organ already embarrassed. As an exception to this principle, must be noted the occasional useful function and relative harmlessness of a waste product, like urea which is a fairly satisfactory diuretic, and like the xanthin group of nitrogenous waste products which act as a stimulant to glandular and nervous activity and which are included in the ordinary beef teas. In employing an animal organ, we must, of course, determine that it corresponds not only in its gross anatomy but in its physiologic function to the crippled human organ in question.

Another important consideration is that our physiologic knowledge is not always even practically complete and that a reasonable test of empiric methods should not be withheld simply to avoid possible ridicule. Natural gas has been found where geologists had proved by a priori arguments that it could not exist and much of our present practical knowledge of organotherapy has been won by men who ignored the accepted teachings of physiology.

NEED OF DETERMINING THE ORGAN AT FAULT.

Yet, the intelligent use of organotherapy requires us to determine the organ at fault, to question seriously whether the mere nutrition of this organ by proteid, carbohydrate, fat, organic compounds of other constitution or salines, can be better carried on by organotherapy or by ordinary food, and to ask just what the function of the crippled organ is. If it subserves a purely mechanic and physical function, like the heart and lungs, or a nervous function, like the brain, cord or nerves, it is difficult to see why the administration of similar structures or expressed constituents can be of any noticeable value. If its function is excretory or if there is the excessive production of a secretion, as in exophthalmic goiter, the a priori probability is that organotherapy will do harm. Even if there is a well established deficiency of a genuine secretion, we must, in general, question whether the supplying of this secretion artificially is the best treatment or whether there are not means for stimulating the normal production of the missing constituent.

GENERAL PRINCIPLES IN ORGANOTHERAPY.

The following general principles are already fairly well supported both by theory and practice:

1. The nutrition, innervation and functional *activity* (not necessarily result of functional effort) are not appreciably benefited by feeding or otherwise introducing the corresponding organ or its juice.
2. Only organs having a definite chemic function can be influenced by organotherapy.
3. Excretory functions are usually impeded and the condition rendered worse by organotherapy.
4. Definite, useful, secretions may be supplemented by organotherapy but the action is only temporary except as physiologic rest may allow permanent recuperation.

So far as the non-visceral parts of the body are concerned, namely, teeth, bones, fibrous tissues, cartilage, adipose, muscles, etc., we have no essential chemic function to consider though, of course, chemic change is at the foundation of all vital activity. The same holds good for the brain, spinal cord and nerves. So long as the requisite chemic substances organic and inorganic, are supplied in abundance, the source or quantitative relations of the various ingredients make no appreciable difference. The bones, teeth, and, to a less degree, the fibrous tissues and special sense organs, suffer little change after their full development is reached.

The lungs are mechanically and physically concerned in a chemic process, as is the circulatory apparatus. We have, apparently, no place for organotherapy in this connection.

THE STOMACH AS AN EXAMPLE.

The stomach illustrates the earliest example of organotherapy, namely the administration of pepsin and hydrochloric acid. We must not be confused by the fact that the term *organotherapy* is of later date. Indeed, the tendency of this as of other branches of ponderable therapy, is toward the use of concentrated and purified active extracts and, ultimately, of the corresponding chemicals, derived by whatever process and from whatever source afford the best and cheapest product.

Ordinarily, the diminution of hydrochloric acid to less than half of its normal proportion—2:1000 at the height of digestion—is an indication for its administration. Some authorities have estimated the quantity of gastric juice formed daily at 30 liters but this seems excessive. In normal chyme of about 500 c.c. bulk, after a hearty meal, the total and combined hydrochloric acid amount to about 1 gram of the pure acid or to 10 c.c. of the officinal dilute hydrochloric acid. We must, in all such discussions, allow for the fact that our standard test meals are small in quantity and relatively easy of digestion. Thus, in our dosage of hydrochloric acid, we should not exceed this amount at one time. In ordinary cases of dyspepsia, combined hydrochloric acid is present but there is none left free. So long as there is a little margin of free acid, digestion will be performed quite well and it is, on the whole, better to give too little than too much. Usually, half to one c.c. of the dilute hydrochloric acid an hour after a meal is sufficient. This dose may be repeated half hourly, two or three times. Apparently, even a little help enables the stomach to resume its function, for the following table from Ehrlich shows a theoretic requirement of acid far in excess of that demonstrated clinically. The numbers given must be multiplied by ten to bring them into terms of dilute hydrochloric acid.

AMOUNT OF PURE HCL NEEDED TO SATURATE 100 GM. .OR C.C.

Milk	.32-42
Beef boiled	2.
Mutton boiled	1.90
Veal boiled	2.20
Pork boiled	1.60
Sweet-bread boiled	.90
Calves' brains boiled	.65
Ham boiled	1.80

Ham, raw	1.90
Liver sausage	.80
Graham bread	.30
Wheat bread	.30
Rye bread	.50
Swiss cheese	2.60
Brie	1.30
Edam	1.40
Roquefort	2.16
Beer, German	.07-15

Lack of the normal proportion of acid is not an absolute indication for supplying the deficiency. In acute and subacute gastritis, the failure of acid secretion is conservative and indicates that the stomach should be allowed to rest, nutrition being maintained by the bowel if necessary. In more chronic conditions, we must balance the need of the stomach for rest and of the body for nourishment.

PEPSIN AND RENNET AS GASTRIC REMEDIES.

Pepsin is almost never indicated as a medicine, its frequent use being due to a misapprehension. Only two or three times in several hundred systematic examinations of stomach contents will pepsin be found wanting and then the stomach will usually be in so bad a condition that it cannot successfully be used as a digesting cavity. With possibly rare exceptions, it may be laid down as a general rule that pepsin is present in sufficient amount if (1) any trace of free HCl is found, (2) a lilac band appears between stomach contents and the ordinary alkaline solutions of copper, such as are used for the sugar tests, the lilac band indicating peptonization and occurring cold or on slightly warming the tube, (3) the stomach contents have the power of coagulating milk at the body temperature. Yet I have once in a case of gastric cancer found the rennin reaction present when there was no peptonizing power. It may also be stated in general terms that when a stomach needs pepsin, it needs rest much more.

Some authors have attempted to show that, according as one part or another of the stomach is affected, pepsin or rennin alone is diminished. More recent experiments tend to show that pepsin and rennin are identical, being distinguished simply because, under different circumstances, different results are produced. These experiments naturally bring up the question as to whether the milk-coagulating ferments of the stomach, intestine and pancreas are identical or distinct and as to whether, if distinct, the pancreatic ferment is simply trypsin acting in another role from that of proteolysis.

While there is no objection to the use of rennet in preparing curds and whey, junket, etc., there is practically no theraupeutic indication for its administration.

FAILURE OF THE DIGESTIVE FERMENTS.

Failure of the digestive ferments of the pancreas and intestine is extremely difficult to demonstrate. They are normally destroyed before the intestinal contents are expelled and even if we succeed in introducing a tube into the duodenum, through the pylorus, we are as yet ignorant of the times at which active secretions should be found and at which a resting period is normal. In progressive failure of strength and emaciation, without other obvious explanation and when the salivary and gastric ferments have failed, we may infer a similar abeyance of pancreatic and intestinal function and we may corroborate this belief by demonstrating an abnormal elimination of undigested food remnants. In such cases, predigested foods are indicated and it does no harm to administer pancreatic extracts or chopped raw pancreas, although normally, the pancreatic ferments are destroyed by the gastric juice so that, in all ordinary dyspepsias, even those considered intestinal, the use of pancreatin, etc., is entirely without effect.

Ptyalin is rarely lacking; indeed, I have never found it absent in adults or children beyond early infancy, although I have examined febrile cases, those with so-called amylaceous dyspepsia, those with bad teeth, and other local conditions that might be supposed to prevent the activity of the salivary glands.

In general for the temporary, artificial increase of nutrition, proteid or carbohydrate, the vegetable ferments are to be preferred, those derived from the pawpaw being of especial value. While the pineapple is supposed to contain a digestive ferment, I have happened, thus far, to find it absent in the specimens examined. Of course any substance which has been heated much above the temperature of the body will have had its ferments destroyed and digestive wines are to be regarded with suspicion.

THE LIVER.

In the case of the liver, we have a secretion containing no ferments, unless accidentally contaminated from the gastric, pancreatic or intestinal juice, but rich in alkalies, and in waste matters, some harmless, some poisonous, and containing practically only two closely allied useful secretions, the taurocholates and glycocholates, mainly combined with sodium. Except by its bulk and alkalinity, bile is of little use in digestion. In certain cases, we may desire to aid the emulsion and absorption of fat by administering the biliary salts mentioned, and, as these are very expensive in the pure state, it may occasionally be justifiable to administer fresh or inspissated bile medicinally, provided that there is no evidence of accumulation of hepatic poisons. But the practical value of bile is not well established, while its contraindications are obvious. The administration of inspissated bile to color the feces or to increase the hepatic function is precisely on a level with the administration of concentrated urine for an analogous purpose.

Liver, like most non-fatty and non-fibrous tissues, is rich in nutriment and, indeed, is practically the only part of the animal body which may contain any notable quantity of carbohydrate. If the animal is killed soon after eating, the liver contains a stock of glycogen which, however, is quite rapidly converted into dextrose, unless the ferment action is checked by immediate cooking or parboiling. While liver is obviously contraindicated in diabetic and gouty or nephritic cases, it is perfectly allowable in health, in reasonable amount. There is no probability that the ferments connected with the glycogenic function are absorbed from liver ingested and certainly not unless the liver is eaten raw.

DIETECTIC VALUE OF KIDNEYS.

From the study of the physiology of the kidneys, it is obvious that neither the organ itself nor its excretion contains anything of value except water and ordinary inorganic and organic nutriment, unless urea be considered as a diuretic and the xanthin derivatives as temporary stimulants on the order of caffeine, with which they have a close analogy. As ordinarily eaten, kidneys are simply meat plus urine. For those with a tendency toward accumulation of nitrogenous waste, kidneys are contraindicated, for those in health, the small amount of urine contained is objectionable only from the esthetic standpoint.

TESTICULAR AND OVARIAN EXTRACTS.

The aphrodisiac, secretory and general nutritive stimulation ascribed to testicular extract, and to extracts of the ovaries and mammary glands, is not altogether established. We may start with the assumption that if the testicles contain a substance of general nutritive value, not shared by other glands in the male body, there must be some corresponding secretion in the female for, with the exception of the sexual organs, metabolism is essentially the same in both sexes. We meet with an *a priori* objection to the theory that testicular extract possesses an absorbable substance of nutritive value from the mere fact that its vaginal injection has rarely had an action which could even apparently be held to indicate general stimulation.

While the physiologic function of the sexual glands certainly conduces to the general well being, the benefit seems to be rather indirect and through the nervous system than otherwise and, if there were a direct chemic tonic in testicular secretion, it should in all instances benefit women who have regular intercourse and this is far from being the case. Moreover, it is scarcely supposable that a secretion naturally destined to pass out from the body should contain such properties nor do we observe stimulation but rather depression from prolonged continence. On the other hand, it is perfectly possible that the testicle, ovary and breast may have an internal as well as an external secretion—if it be allowable to apply the latter term to the rupture and discharge of a follicle of the ovary—and we have precedent for such a hypothesis in the case of the liver and pancreas which produce ferments like true ductless glands as well as discharging a secretion through a duct. It certainly is true that the loss of the sexual glands is not usually compatible with a vigorous existence and that the metabolism is conspicuously changed in castrated men and animals, with a tendency toward obesity.

The Ponce-de-Leonic claims made by Brown-Secard for testicular extract have been proved to be absurd yet it is possible that further experimentation with testicle and ovary and even mammary gland, may show a genuine tonic influence. Thus far, the literature of the subject is very meager and the relief claimed has not been well established, even in the accounts of the advocates of this branch of organotherapy. The only substance at all characteristic thus far discovered in any of these organs is ethylenimine phosphate in the semen but this is also found pathologically in sputum and it seems to be merely excrementitious. This leaves for discussion the ductless glands, including the internal secretion of the pancreas, which involves the topic of diabetes.

THE SPLEEN.

The spleen is, perhaps, the best example of an organ having a "vital" function, in the sense that it cannot be dismissed as essentially chemic, nervous, mechanic or physical in its action. It is virtually a large lymphatic gland in which not only lymph but blood percolate through lymphoid tissue. Till very recently, this was supposed to be unique but observations have lately been reported on what may be termed blood-lymph glands, which have hitherto been mistaken for true lymph nodes but which mingle blood and lymph very much after the analogy of the spleen. Apparently, red cells are developed from white ones in the spleen and worn out red cells are destroyed. All of these changes are attended with marked chemic activity and increase of temperature but none of the chemic products seem to be essential or to cause any special phenomena in the body. It has been asserted and denied that the secretion of the spleen is necessary to the formation of ferments in the pancreas. Certainly there is nothing in the arrangement of blood or lymph channels to corroborate this hypothesis.

While spleen is occasionally eaten, its deleterious or beneficial effects are unknown.

THE USE OF THYMUS EXTRACT.

The thymus obviously has to do with fetal and, perhaps, with infantile development, its maximum size being reached at about the end of the second year. No intrinisic functional disease or organic disease producing derangement of function is known, though traumatic and septic conditions are met with. It is possible that thymic asthma is something more than dyspnea due to pressure. It is asserted that thymus extract is a weaker substitute for thyroid but of this, I have never been able to see the slightest clinical evidence.

Mendel (Muench. Med. Woch., 1902) quotes Friedleben as having found the thymus small in 300 necropsies on children who showed evidence of rhachitis. He claims good results from organotherapy, using 1 c.c. daily for each month of the child's life. He states that this treatment restores the function of the thymus and that when the latter is incurably diseased, as by tuberculosis, the improvement is only temporary.

THE USE OF PITUITARY EXTRACT.

The pituitary body is partly nervous, partly glandular in function. Disease of this body has been clinically connected with gigantism if developed before the bones have become fixed in size, and with acromegaly if occurring later in life. It is relatively rather frequently associated with myxedema and there seems to be some association of function between the pituitary and the thyroid, both of which are originally outgrowths of the alimentary canal. Theoretically, if one form of disease of the pituitary causes overgrowth of the skeletal tissues, there is reason for supposing that stunted development is due to some opposite disease but this has not been demonstrated. Enlargement of the pituitary, enlargement of the thymus and either enlargement or diminution of the thyroid have been found in association. While it has been fairly well established that there is a relation between enlargement of the pituitary and overgrowth of bone and its associated fibrous and cartilaginous structures, we do not yet know whether this is due to (1) some nervous influence, (2) the failure to remove some substance which normally exerts an inhibitory action, (3) the overproduction of a stimulant to the skeletal tissues. The term *enlargement* has been used instead of *hypertrophy* to avoid the expression of an opinion as to the nature of the change. Moreover a histologic hypertrophy does not necessarily imply an excess of function. If it did in this case, there would apparently be a contraindication to the use of pituitary extract in either acromegaly or gigantism, but possibly an indication for its employment in cases of stunted growth. From the practical standpoint, the whole matter requires careful empiric experiment.

Kuh (*Journal of the Am. Med. Assn.,* Feb., 1902) has relieved the symptoms though, of course, not the deformity in 2 of 3 cases of acromegaly, by the administration of pituitary body.

THE SUPRARENAL BODIES AND ADRENALIN.

Like the pituitary, the suprarenal bodies are both nervous and glandular in structure and in function. An apparently definite active principle—or group of active principles—has been carefully studied and nearly or quite isolated, as "adrenalin," which is capable of administration in definite dose and with little tendency to decomposition, such as occurs with the dried or partially extracted gland. Its action is to stimulate unstriped muscular tissue. While originally, and still almost entirely, employed to check hemorrhage and to contract turgescent vascular tissue as in the nose and throat, the writer has used it considerably as a general vascular and cardiac stimulant, and to raise arterial tension, and there seems to be a field for its use in subinvolution and other relaxed states of the uterus, possibly as a substitute for ergot to cause uterine contraction and similar effect on the prostate. By raising the tone of the dermal vessels, it checks sweating and there may be further fields of usefulness in regard to the ciliary and iris muscles and all other smooth muscular organs.

Disease of the suprarenal bodies, commonly called Addison's Disease, is usually tubercular in its histologic pathology but it may be due to other lesions. Most cases show a general loss of tone and strength, especially involving the abdominal glands so that I have observed almost complete failure of ferments, with well demonstrated achylia gastrica and, apparently similar achylia pancreatica. There is also usually an increase in pigment deposit and I have observed a relative eosinophilia of 10—12 per cent., the leucocytes in general not being increased. Dr. C. A. Herter has demonstrated that the administration of adrenalin in considerable doses, produces a glycosuria but that this effect is most marked when the pancreas is painted with a solution and that other reducing agents have a similar action. The glycosuria is not due to vascular contraction and it does not occur to an appreciable degree after the ordinary therapeutic use of the substance. The pigment formation or accumulation in Addison's Disease suggests that the suprarenal bodies are both secretory and excretory. The former function can be supplied by the administration of adrenalin while the pigment does not seem to be increased or diminished by it. Thus, in Addison's Disease, we can benefit the symptoms due to lowered arterial tension but we apparently do not increase and certainly do not materially improve any other symptoms.

THE THYROID AND THYROID EXTRACT.

Within the last few years, our knowledge of the physiology and nosology of the thyroid has been brought to a fairly satisfactory state. Without reference to the macroscopic and histologic changes in the gland, we may, for medical purposes, suggest the following functional classification of its diseases:

1. Enlargements which do not interfere with function and which call for absorbent or operative measures only for cosmetic or precautionary purposes.
2. Conditions of depression, which may coincide with apparent hypertrophy, atrophy or unchanged size. These are, in the main, of two types:
    A. Congenital—cretinism.
    B. Acquired—myxedema.
3. Conditions of excitation, usually accompanied with demonstrable hypertrophy and conforming more or less closely to the type of exophthalmic goiter.

So far as we can judge from the results of administration of thyroid extract, the principal function, possibly the only function, of the thyroid is to furnish the body with a useful substance, namely an organic compound of iodin and, according to some experimenters, of arsenic as well. In females, the thyroid usually enlarges before menstruation and in pregnancy and the menstrual blood contains an excess of iodin and, at times, of arsenic. It is not established that the latter is invariably or necessarily present. That the thyroid has no marked—if any—excretory function, is apparently demonstrated by the completeness with which the artificial administration of the extract removes the symptoms of depressed conditions. The benefit is not permanent but it can apparently be maintained indefinitely by continuing the administration of the extract, with such intermissions as are indicated by symptoms of overdose. In exophthalmic goiter and allied conditions, which I believe to be quite common, especially during puberty and adolescence, in atypic form, the administration of the extract increases the symptoms.

Sometimes, cases are encountered which apparently unite the manifestations of the two opposite types of functional derangement. No adequate explanation of such cases is as yet forthcoming and they must be treated empirically.

The use of thyroid in obesity and in various other obscure metabolic perversions, is not satisfactory, either from the theoretic or the practical standpoint.

RED MARROW IN BLOOD DISEASES.

In various essential blood diseases, with destruction of red cells, the bone marrow, as a matter of compensation, regains its embryonic condition and aids in the reconstruction of red cells. This change is macroscopically evinced by the appearance of a red color, partly due to increased circulation, partly to the hemoglobin elaborated for the new cells. It is obvious that the administration of red marrow, or its extract, can in no way supply a vital constructive function but it probably does facilitate the provision of hemoglobin for developing red cells. Whether other ingredients of special value are furnished or whether red marrow is a better menstruum for the administration of hemoglobin than blood or muscle, is not demonstrated.

THE USE OF BONE MARROW.

In rhachitis, the administration of calcium salts and of other ingredients of bone, may, perhaps, be provided for in the best way by the use of bone marrow and bone scrapings. At any rate, bone marrow is a palatable form of administering fat and inorganic salts, highly appreciated by all savages and too much neglected in civilized life. The special indications in various forms of bone disease have not been placed upon an accurate basis but the general principles will readily occur to one who will study the exact conditions present in any particular disease.

INORGANIC SALTS.

A subject that should be more thoroughly studied is the normal and perverted metabolism leading to the elimination of phosphates, sulphates and chlorids, the principal inorganic acid radicles present in the body and in its secretions and excretions. Their clinical estimation in the urine has been rendered fairly simple and exact by the researches of the late Dr. Charles W. Purdy of Chicago. Unfortunately, we do not yet understand the full significance of their variations, whether due to differences in ingestion of salines, to metabolism of organic compounds and whether due to attempts to get rid of unnecessary if not actually harmful excesses, or calling for a restitution of these salts or their antecedents.

THE USE OF BLOOD SERUMS, ETC.

In the use of blood serums, and various organic extracts, it is well to observe some precaution against the possible action of precipitins, haemolysins and other substances liable to produce bio-chemic reactions. As even venoms of the highest toxic power are usually harmless, if administered by the stomach, there is probably no danger to be anticipated from similar administration of any therapeutic organic extract or serum. Intravenous or even interstitial injection of such products is, however, to be resorted to with considerable hesitancy until definite experimental knowledge has been obtained, nor can we rely implicitly upon experiments upon the lower animals whose relation to one another is less remote than to man. Tests upon monkeys are of greater value, in this connection. Korschum and Morgenroth *Berlin Klin. Woch.,* Sept. 15, '02) detail certain experiments which show that various organs differ greatly in their haemolytic action, that this property resides mainly in the cells and is wanting or very faint in clarified extracts and that it is destroyed by exposure to a temperature of 56 degrees C., for one-half to one hour. It is still impossible to say how far we may generalize from their experiments, in which only a few laboratory animals were used. Nor can we in all instances rely upon the clarified or heated extracts, for the properties desired in organotherapy.

CHAPTER XIII.

DIABETES.

The Islands of Langerhans in the pancreas are practically ductless glands, elaborating a glycolytic ferment which is taken up by the blood and which renders possible the oxidation of glucose, and probably of other carbohydrates, in notable quantity at the body temperature. While some slight oxidation has been shown to take place, under similar conditions, in an alkaline solution corresponding in strength to that of the blood, it is entirely inadequate. While a superficial consideration shows a glycosuria as the most conspicuous sign of diabetes, the writer believes that a thorough study of any case will enable a clear distinction to be made between a mere glycosuria and true diabetes. The former occurs in all instances in which an excess of glucose is present in the blood, including, of course, all instances of diabetes under ordinary diet, and usually under restricted diet.

GLYCOSURIA AND ITS INDICATIONS.

Glycosuria, then, is simply an indicating of hyperglycemia and is in line with the elimination of salines, albumin, or anything else present in the blood in superabundance. Hyperglycemia may be due (1) to the experimental injection of glucose into the blood or tissues, (2) to the ingestion of an excess of sugars or, possibly, to undigested carbohydrates, as compared with the power of the glycogenic function of the liver to deal with sugar, (3) to the failure to remove sugar from the blood by other means than renal elimination, the only means known being by oxidation into water and carbon dioxid. The first subdivision, being entirely artificial, needs no discussion.

The second may depend upon an increase of ingestion or a decrease of glycogenic function, from the normal standards. By actual investigation, of an empiric nature, we know that the limit of the normal glycogenic function is reached when about 150 grams of glucose or cane sugar is ingested at one time, the exact limit varying in different individuals and in the same individual at different times, just as similar arbitrary limits of any other organic function vary. Glycosuria due to the administration of phloridzin, to other drugs, to puncture of the floor of the fourth ventricle, to head injuries, and to various other toxic or traumatic influences may, a priori, affect either the glycogenic function or the glycolytic function and, therefore, may be classified under either the second or third category of causes of hyperglycemia or both.

While Dr. C. A. Herter's experiments with adrenalin have shown that this substance causes glycosuria through local action on the pancreas, it does not appear that any of these causes produce a genuine failure of glycolysis, of serious degree. Contrary to what might be expected, obvious disease of the liver, even of marked gravity, seldom produces a conspicuous failure of the glycogenic function although it is usually slightly diminished, as determined by the test of ingestion of 150 grams of glucose. But the analogous fact is true of practically all functions of the liver. For example, Bouchard has estimated that the waste matter normally eliminated through the liver would kill if allowed to accumulate nine hours, yet patients with markedly contracted and sclerotic livers live for years without conspicuous signs of toxemia.

DEFINITION OF DIABETES.

In the opinion of the writer, unless another source of the glycolytic ferment should be discovered, diabetes should be defined as a disease of the pancreas, due to the failure of this glycolytic ferment. As a result of the failure to oxidize glucose, hyperglycemia and glycosuria successively occur. These conditions in themselves are serious, the former tending to irritate all tissues and to interfere with normal osmotic processes while the latter usually produces nephritis, if it continues long enough. But the main trouble is that the body is in the condition of an engine which cannot burn its normal fuel. Thus, the fats and proteids must be used in undue proportion as fuel foods, the production of energy is inadequate and the tissues themselves are drawn upon, so that emaciation occurs. Sometimes the loss of weight is progressive while the subcutaneous fat remains thick. Often, more sugar is eliminated than has been ingested in the same day and this has been taken to mean that the tissues have been broken down into carbohydrate. It may, however, merely signify the elimination of stored glycogen.

Remembering that the essence of diabetes is inability to oxidize glucose, we have a clue as to diagnosis and treatment. So long as a fair degree of bodily energy is maintained, there must be a relatively high oxidation of nitrogenous tissue and food, so that the elimination of urea, etc., will be much increased.

Thus, true diabetes is unquestionably indicated by a combination of glycosuria and azoturia. Indeed, the former may almost or, rarely, quite disappear under dietetic treatment, while the latter remains. Obviously, when the renal eliminative power is much diminished, which nearly always is the case late in the course of the disease, the nitrogenous elimination falls to or even below normal or the same reduction of azoturia may be caused by the general failure of assimilation and the gradual reduction of bodily proteid as in any other form of inanition. This phase of the problem is rendered comparatively easy for the reason that practically all of the nitrogenous waste of the body is excreted through the kidneys, mere traces leaving by the skin and lungs and only a few grams by the liver. Personally, I believe that it is of more importance to watch the nitrogenous than the saccharine waste.

True pancreatic diabetes may be due to organic or functional disturbance and the latter may involve organic or functional disturbance of the sympathetic nervous system.

ADMINISTRATION OF THE GLYCOLYTIC FERMENT.

From the standpoint of organotherapy, it would seem possible to supply the glycolytic ferment from time to time, yet the difficulties may prove insuperable and Lepine's preliminary experiments have not been markedly successful. In all probability, injection into the blood or subcutaneous tissues will be necessary although it is possible that, like thyroid extract, absorption from the stomach or intestine may occur. The glycolytic ferment could certainly be supplied by transfusion but, to accomplish this to an adequate degree and sufficiently often, would be practically impossible. The average butcher does not know the pancreas but it could, of course, be obtained without difficulty and in sufficient quantity at any large slaughter house. Whether the Islands of Langerhans could be isolated or whether the presence of digestive ferments would produce serious results if the extract should be introduced into the blood, is merely a matter of speculation.

DIETETIC TREATMENT OF DIABETES.

The dietetic treatment of diabetes is practically the same for all stages and for all varieties, subject, however, to the important qualification that each case, whether due to organic pancreatic lesion, to sympathetic lesion or neurosis, and whether early or advanced, mild or severe, requires a wise mingling of theory and empiricism. Not only the appetite and general symptoms but the condition of the urine must guide us in the regimen.

Amount of sugar, amount of urea, total amount of urine and specific gravity are the important points to consider. The inference of total solids from the total amount and specific gravity can not be depended upon. Given, for instance, 3,000 c.c. of urine, of a specific gravity of 1,030, containing 300 grams of sugar and 100 of urea, the indication is plain to cut off the carbohydrates as absolutely as possible and to nourish on fat and food-proteid, so as to prevent the wasting of nitrogenous tissues. Fortunately, we usually find that the various urinary abnormalities decrease pari passu. On the other hand, given a case with comparatively small elimination through the kidneys, with not much glycosuria, with secondary nephritis or indications of toxemia due to some of the so-called diabetic poisons, and the course of the disease must be steered away from the dangers of nitrogenous catabolism, even if we have to pass nearer than we like to the carbohydrate menace. Even more important is the evidence of excessive oxidation of fat with faulty catabolism, presented by the finding of betaoxybutyric and diacetic acid and acetone in the urine. Sometimes it is very easy to nourish the patient on a diet in which fat supplants almost all of the carbohydrate, more often, fuel-food must be largely composed of proteid and considerable carbohydrate must also be given.

Estimated mathematically, bare subsistence requires the production of 2,000 calories daily. We can increase the consumption of proteid to 150 Grams daily, without harm or difficulty. At 4.9 calories per Gram, we can thus provide for about 735 calories. At 9.3 calories per Gram, 140 Grams of fat or about 50 Grams more than the ordinary ration, will supply the additional energy absolutely required, with the body in a state of quiescence. The following ration conforms fairly well with the minimum theoretic requirement:

	Proteid.	Fat.	Carbohydrate.
6 eggs	35	30	traces.
Butter	...	45	traces.
Lean meat, kilo	100	18	traces.
Salt pork, 30 Grams	3	27	traces.
Cream, 250 c.c.	7	65	traces.
	145	185	

Bacon, salt pork, butter, cream, salad oil, mayonnaise, ham gravy, fresh meats with an abundance of fat, etc., may be substituted for one another, so as to afford a considerable variety. Various green vegetables, comparatively innutritious and containing little carbohydrate, may be given but the great trouble with all antidiabetic dietaries is that we have to contend with a genuine appetite for carbohydrates. Thus while we may tickle the palate with gelatinous desserts, ice cream, etc., sweetened with saccharine and may allow a considerable variety of combinations of fat and proteid and of fodder vegetables which provide the antiscorbutic requisites and which do not contain much carbohydrate—or any other nourishment of organic kind—we cannot satisfy the cravings of the normal appetite. Bread is especially missed and the gluten flours are not reliable, many of them containing even more starch than the ordinary. To paraphrase Lincoln's epigram, "We can fool some of the appetites all of the time and we can fool all of the appetites some of the time, but we cannot fool all of the appetites all of the time," so that it is absurd to suppose that we can cut out of the dietary so important an ingredient as carbohydrates and devise any substitutes that will render life comfortable and enable the bodily energy to be maintained at par.

All text books and most articles on diabetes lay down lists of food stuffs that may and that may not be eaten by diabetics. These lists are misleading because they are apt to give the impression that certain vegetables may be eaten with impunity and that there are intrinsic differences that render some starches harmless while others are harmful. On the whole, laevulose and galactose are less harmful in diabetes than dextrose and thus the sugars that form less dextrose and relatively more of the other two mono-hexoses, may be nutritious in diabetes but if the sugar has passed through the glycogen stage in the liver, it is apparently changed into dextrose, before reaching the general circulation. Moreover, neither the chemistry of vegetables and fruits is so definitely known nor is the theory that diabetics can oxidize levulose, so well established, that we can follow with certainty, any diet list. In many respects, the diet lists are erroneous, especially in allowing milk, gluten flour, etc., in too great quantity.

The following diet list is due mainly to Dr. James Tyson:

ARTICLES ADMISSIBLE FOR DIABETICS.

Shellfish, oysters and clams, raw or cooked in any way without flour.

Fish of all kinds, fresh or salted, including lobsters, crabs, sardines, and other fish in oil.

Meats of every variety except liver, including beef, mutton, chipped dried-beef, tripe, ham, tongue, bacon and sausages; also poultry and game of all kinds, with which, however, sweetened jellies and sauces should not be used.

Soups.—Clear bouillon and other soups, beef tea and broth made without flour, rice, vermicelli or other starchy substances, and without the vegetables named below as inadmissible.

Vegetables.—Cabbage, cauliflower, artichokes, Brussels sprouts, broccoli, green string beans, the green ends of asparagus, spinach, dandelion, mushrooms, tomatoes, lettuce, endive, coleslaw, olives, cucumbers fresh or pickled, radishes, young onions, watercresses, mustard, turnip tops, celery tops, or any other green vegetables.

Bread and cakes made of gluten, bran, aleuronat, or almond flour, or inulin, with or without eggs and butter. Griddle-cakes, pancakes, biscuit, porridges, etc., made of these flours. No pastry permitted unless made of the admitted flours and without sugar.

Eggs in any quantity and prepared in all possible ways, without sugar or ordinary flours.

Nuts.—All except chestnuts, including almonds, walnuts, Brazil nuts, hazelnuts, filberts, pecan nuts, butternuts, cocoanuts.

Condiments.—Salt, vinegar and pepper in moderate quantity.

Fruits.—Oranges, lemons, cranberries, cherries. gooseberries, apricots, strawberries, all in *very* moderate quantity.

Jellies.—No fruit jellies are allowable but those made of gelatine and flavored with wine, etc., and sweetened with saccharin.

Drinks.—Coffee, tea, and cocoa-nibs with milk or cream, but without sugar. Also milk, cream, soda (carbonated) water, and all mineral waters freely; acid wines, including claret, Rhine and still Moselle wines, very dry sherry, unsweetened brandy, whisky and gin. No malt liquors except those ales and beers which have been long bottled so that the sugar has been converted into carbonic acid gas and alcohol.

Imitations of orange- and lemonade and other fruit drinks may be prepared from the essential oil, citric acid or acid phosphates, and saccharin.

Vegetables to be specially avoided.—Potatoes, white and sweet, rice, beets, carrots, turnips, parsnips, peas and beans; all vegetables containing starch or sugar in any quantity.

THE CARBOYHYDRATES IN DIABETES.

There used to be a great deal said about the toxic action of carbohydrates in causing the elimination of a greater amount of sugar than could be accounted for by ingestion. Since more accurate studies of the urine have been made, we hear little about this phenomenon and, while in any series of experiments on metabolism, we shall often find that the intake and outgo do not exactly balance on any particular day, it does not appear that any such toxic action on the part of carbohydrates, has been absolutely demonstrated. If it were so important as was formerly held, it would have been manifest in nearly all cases, for no diabetic diet is absolutely free from carbohydrate. In dealing with diabetics, we have to contend with different manifestations of the carbohydrate appetite. If the patient desires sweets, we should endeavor to deceive his palate with saccharin and to supplement this with levulose—commercially known as diabetin—and such fruits as contain mainly levulose and mannite.

MILK IN DIABETES.

While milk may usually be allowed in cases of mild diabetes, there are cases in which a strict regimen must be maintained and in which it is difficult to administer sufficient nutriment. Robert Hutchison describes the method of preparing a sugar-free milk, as follows: 1 liter of skimmed milk is heated to 38 degrees C. and 100 c.c. of a 10 per cent solution of glacial acetic acid is added. After fifteen minutes, the casein is drained onto fine muslin and the whey, containing the lactose, is filtered off without pressure. The curd, partially freed from lactose, is rubbed to a smooth paste in a mortar and twice strained as before, being washed each time with ½ liter of distilled water. The casein is now dissolved, in a mortar with 100 c.c. of a 2½ per cent. solution of potassium hydrate or sufficient to react faintly alkaline to phenolphthalein. There is now added 100 grams of clotted cream which brings the fats approximately to normal without adding an appreciable amount of lactose. The consistence is restored by adding 5 grams of gelatine, previously dissolved and the taste is brought to the normal sweetness by adding six centigrams of saccharine, also dissolved. The whole is now restored to its original volume by adding water up to one liter and is once more strained. It is said that this preparation can scarcely be distinguished from the original milk, while it is almost absolutely free from carbohydrate but, otherwise, represents the full organic nutriment of milk.

SYSTEMATIC TREATMENT OF DIABETES.

A good rule as to dietetic treatment is to begin with a fat and proteid diet, as strict as the composition of natural food stuffs allows. If no acetone, diacetic acid or other "diabetic" products appear in the urine, if the patient is fairly well nourished and not too uncomfortable, this diet should be adhered to till the urea falls to normal and sugar disappears according to rough, copper tests. When this point has been reached or when for the other reasons implied, the strict diet has proved a practical failure, some carbohydrate must be given, and, usually, the patient will crave it in the form of bread stuffs. If he can be satisfied with levulose, lactose of milk, inulin, almond-meal, aleuronat-meal or a true gluten-flour as a basis for bread, so much the better. But, usually, it will be found necessary to allow certain ordinary foods containing considerable amounts of carbohydrate. Just how much may safely be given, is problematic. A very little bread or cracker will appease some appetites and will allow a considerable increase in the amount of butter eaten. Tyson lays down the arbitrary rule that carbohydrate may be given in such an amount that the sugar in the urine does not exceed 1 or 2 per cent. The following case illustrates a favorable and easily managed case.

Mrs. M., aged 47, first consulted me Jan. 25, 1896. Two years before she had been much excited on account of a family quarrel and forty days later, she noticed increased thirst, weakness, etc. With some remissions, there was a typic history of diabetes, including boils, polydypsia and polyuria, 2 gallons of urine having actually been measured in a day. She had lost considerable weight under a persistent subcutaneous layer of at least 1½ inches but she still weighed between 70 and 80 kilograms. The first sample of urine measured between 6,000 and 7,000 c.c., allowing for errors in domestic measures. The specific gravity was 1,040, urea 144 Grams, sugar 300 Grams by Einhorn's saccharimeter, which is not as accurate as the old-fashioned specific gravity and fermentation method. She was placed on a strict diet of eggs, salt and butter. By February 3, she was drinking only four glassfuls of water daily and the urine was reduced to 2 or 3 liters. February 4, the urine measured 3,000 c.c., specific gravity 1,034, urea 81 Grams, sugar 75 Grams. February 22, the urine had fallen to 1,500 c.c., specific gravity 1,021, trace of sugar, 45 Grams of urea. This examination illustrates the importance of estimating the azoturia. It is perfectly possible that a patient might ignorantly happen upon a suitable diet or might have some temporary digestive disturbance which would cut off practically all food for a few days. If the diagnosis had not previously been made, the ordinary sugar tests would fail whereas the enormous increase of urea would still be diagnostic. March 12, a qualitative examination failed to detect sugar by either the copper or picro-nitric acid test. March 13, the urine was only 1,000 c.c. in amount, with no sugar and only 32 Grams of urea, the patient for a few days previously, having had some meat and a very little bread. From this time, she was directed to take bread and butter ad libitum and to report in a week. Owing to subjective improvement, she did not report till May 3, when the urine measured 900 c.c., 1,016 specific gravity, no sugar, 24.3 urea. December 16, she had an exacerbation, on account of a shooting affray in the neighborhood. The urine amounted to 1,000 c.c., 1,030 specific gravity, urea 17 Grams, sugar 20 Grams, band of albumin and one hyaline cast. December 22, 1,000 c.c., 1,026 specific gravity, 17 Grams of urea, no sugar, band of albumin. The patient was put upon the same strict diet and improved subjectively. She did not report further but, on April 9, during an intercurrent attack of bronchitis, the urine measured 4,000 c.c., specific gravity 1,030, 60 Grams of urea, 180 of sugar. Diabetic treatment was again insisted upon and the urine fell to 1,000 c.c. a day, within two days. I have had no further opportunity to examine the urine except on February 21, 1898, when a single sample was found normal qualitatively. Without any care in diet, the patient has remained free from subjective symptoms of any kind. In June, 1904, the patient was said to present renewed symptoms of diabetes but in mild form.

IMPORTANCE OF CLINICAL ESTIMATIONS.

It should be observed that clinical estimations of urea by the hypobromite test, are to be taken with reserve. Dr. Elliott P. Joslyn (*Boston Medical and Surgical Journal,* Dec. 25, 1902) has called attention to the fact that, in diabetes, the results of this method, ordinarily sufficiently accurate for clinical purposes, are greatly exaggerated by the inclusion of nitrogen from ammonium salts. Nitrogen comprises 28/60 of the molecular weight of urea, so that urea cannot much exceed twice the weight of nitrogen obtained by accurate analysis. Indeed, on account of the presence of ammonium salts and other nitrogenous waste matters, one might say that the urea can scarcely equal twice the weight of nitrogen. Joslyn cites two examinations of diabetic urine in which the urea by Squibb's method—which depends upon the liberation of nitrogen by hypobromite—amounted to 80 and 48 Grams, respectively. By Braunstein's method, it was shown to be only 43.6 and 29.6, respectively. The acetone was 32.3 and 26.7 and the beta-oxy-butyric acid 96.3 and 69.8, and ammonia 3.07 and 4.39, respectively. However, for clinical purposes, the exact intermediate steps in the nitrogenous catabolism are not important and the urinary nitrogen, calculated as urea, by the hypobromite method, remains not only a convenient but a fairly accurate scientific estimation of nitrogenous catabolism. As, in gastric comparisons, it is convenient to calculate total acid in terms of theoretic equivalent of hydrochloric acid, so in the estimation of diabetic waste, it is better to estimate the nitrogenous elimination in terms of urea, although Joslyn's criticism is a valuable contribution to medical science, if substantiated. The general opinion, however, is that clinical methods underestimate rather than exaggerate urea.

Not all patients are so amenable to dietetic treatment as this one, who seems to have had a functional sympathetic disturbance. Rather than try to follow literally, one of the ordinary diabetic dietaries, it is better to formulate a fat and proteid schedule and to add to this bread, crackers, potatoes or other vegetables, in small amounts, not exceeding 50 Grams of carbohydrate in 24 hours at first, and returning to strict diet or extending the list, according to results.

In all such discussions, we must remember that while diabetes is not so rare as certain "museum" diseases, like myositis ossificans, sensory hemiplegia, etc., it is still difficult for any one physician to acquire a considerable experience in it. According to the latest census, there are about 9.4 fatal cases annually, for 100,000 population, corresponding to nearly 200 physicians. Thus, there is urgent need of amassing statistics of accurately observed cases and, especially, of testing upon a large scale, the possibilities of organotherapy which have been suggested by Lepine.

CHAPTER XIV.

OBESITY AND LEANNESS.

The varieties of obesity have been variously classified by different clinicians. The writer would suggest a simple division into pinguidity or mere fatness, due mainly to excessive ingestion, and true obesity, depending mainly on a failure of oxidation. The former is comparable to glycosuria, the latter to diabetes mellitus. In diabetes, the solubility of the unoxidized sugar leads to its conspicuous elimination in the urine; in obesity, the unoxidized fat accumulates in the areolar tissues. The two conditions of failure of oxidizing power may be united in the same individual, but not with such frequency as to show anything more than a coincidence. The lack of ability to oxidize the staple heat and force generator, glucose, usually determines an excess of proteid oxidation.

As fat is never of much active, immediate service to the body, no such compensatory superoxidation occurs and, indeed, there may also be a state of proteid suboxidation—lithemic obesity. Moreover, the failure of fat oxidation is never of comparable degree with that of sugar oxidation in diabetes and, if the entire normal ingestion of fat were deposited in the body, there would be a progressive gain of fat of say 800 grams a week, or 1,000 grams of adipose tissue, which is never maintained for any such length of time as the duration of a moderately severe case of diabetes. On the other hand, just as sugar seems to be actually formed from other than carbohydrate foods in diabetes, proteids and carbohydrates undoubtedly add to the deposition of fat in obesity. True obesity often develops in light eaters or, at least, persists for years, after the establishment of abstemious habits.

TREATMENT OF PINGUIDITY.

The dietetic treatment of pinguidity is simple and, granting that the patient cooperates, successful. Methods of rapid reduction are both harmful and unnecessary. The patient should make an accurate report of the ingesta for a week, counting crackers, biscuit, etc., and eggs, which do not vary much in weight, measuring milk and weighing ordinary solids. This report should correspond as closely as possible to the ordinary habit of eating and drinking. Criticizing this report, the physician should direct a similar dietary, eliminating gross errors, in which the proteids amount to about 100 grams, the carbohydrates to 250, the fats to 20 or 30 and the water to 1,000 to 1,500 c.c. As adipose tissue contains only about 80 per cent. of pure fat, every 8 grams of the latter excluded from the diet, means a reduction of weight of 10 grams.

The reduction of fat to a daily ration of 20 to 30 grams, instead of 90 which is the normal, should correspond to a daily loss of weight of 75 to 90 grams, or up to about a pound and a half a week. Even the reduction of a pound a week is sufficient under ordinary circumstances and a reduction signifying more than a substitution of tissue fat for the deficit of fat in the diet should lead to an increase in the carbohydrate allowance, as it is unwise to diminish the available heat and energy of the body, except slightly. The following table, compiled by Dr. Heinrich Stern, is well adapted to conditions in America. Of course, more attention should be paid to height than to age in estimating weight desired and whether in reducing the corpulent or building up the lean, respect should be shown to the normal individual variation in fat deposit, by stopping when within ten per cent of the average.

While fat is of some service to the body as packing and to prevent excessive radiation of heat, and as a reserve of nutriment, its relative lack of value is well shown by the following table compiled by physiologists to represent the average of various observations.

During starvation adult animals die when about 50 per cent. of the body weight has been lost; young animals when about 20 per cent. has been lost. In general, the less important the tissue, the greater proportion of it is lost during starvation, as shown in the following table:

AVERAGE NORMAL RELATIONS OF AGE, HEIGHT AND WEIGHT.

	Men.				Women.			
Age.	**Body, inches.**	**Height, cm.**	**Body, pounds.**	**Weight, kilo.**	**Body, inches.**	**Height, cm.**	**Body, pounds.**	**Weight, kilo.**
1 ..	28.74	73	21.78	9.9	28.50	72.4	20.24	9.2
2 ..	32.67	83	28.16	12.8	32.44	82.4	24.60	11.2
3 ..	35.82	91	32.70	14.9	35.59	90.4	29.04	13.2
4 ..	38.18	97	36.68	16.9	37.95	96.4	33.	15.
5 ..	40.55	103	39.60	18.0	40.31	102.4	35.20	16.
6 ..	42.91	109	43.34	19.7	42.68	108.4	38.50	17.5
7 ..	45.27	115	47.08	21.4	45.04	114.4	41.58	18.9
8 ..	47.63	121	51.7	23.5	47.40	120.4	40.92	18.6
9 ..	50.	127	55.60	25.3	49.76	126.4	49.06*	22.3
10 ..	52.36	133	60.94	27.7	52.13	132.4	54.56	24.8
11 ..	54.33	138	66.40	30.2	54.09	137.4	58.52	26.6
12 ..	56.30	143	72.60	33.	56.06	142.4	67.98	30.9
13 ..	58.27	148	78.10	35.5	58.03	147.4	77.44	35.2
14 ..	59.84	152	84.40	38.4	59.60	151.4	87.34	39.7
15 ..	61.42	156	105.80	48.1	59.84	152.	97.02	44.1
16 ..	63.39	161	120.10	54.6	60.	152.4	97.46	44.3
17 ..	65.35	166	132.80	60.4	60.39	153.4	.....	....
18 ..	66.93	170	136.40	62.	61.18	155.4	.....	....
19 ..	67.32	171	138.60	63.	61.84	157.	118.80	54.
20 ..	67.72	172	144.10	65.5	62.36	158.4	122.10	55.5
25 ..	68.90	175	151.80	69.	63.15	160.4	124.30	56.5
30 ..	69.29	176	154.	70.	63.78	162.	124.30	56.5
35 ..	68.90	175	157.30	71.5	63.54	161.4	127.60	58.
40 ..	68.90	175	166.60	73.	63.39	161.	133.10	60.5
45 ..	68.11	173	161.70	73.5	62.99	160.	132.	60.
50 ..	67.72	172	156.20	71.	61.81	157.	128.70	58.5
55 ..	67.32	171	151.80	69.	61.42	156.	126.50	57.5
60 ..	66.93	170	149.60	68.	61.02	155.	126.50	57.5
70 ..	66.14	168	145.20	66.	60.23	153.	117.70	53.5

*Heinrich Stern.

Of fat, forming about 25 per cent. of the body, 97 per cent. is lost before death by starvation.

Of muscle, forming about 50 per cent. of the body, 30 per cent. is lost before death by starvation.

Of liver, forming about 2½ per cent of the body, 56 per cent is lost before death by starvation.

Of blood, forming about 8 per cent. of the body, 17 per cent. is lost before death by starvation.

Of spleen, forming about ½ per cent. of the body, 63 per cent. is lost by starvation.

Of heart and brain, practically nothing is lost by starvation.

PRELIMINARY DETERMINATION.

While no sharp line can be drawn in practice between pinguidity and true obesity, experiment soon shows which is the real condition, as the latter is much more obstinate. It is well to form, at the outset, a definite idea of what is to be accomplished. The patient is to be weighed in light clothing at the beginning of treatment and the weighing should be repeated at intervals of a week or two, with due precautions as to uniformity of clothing and accuracy of scales. Allowance should be made for abnormally large or small bones, tumors, massive breasts, unusual muscular development and, per contra, for loss of weight by amputation. Excepting the surgical rule of thumb that a hip amputation removes a quarter of the total weight, the writer has been unable to find any statistics as to the weight of amputated limbs. It is scarcely necessary to point out that dropsy and myxedema should not be confused with fat.

DIET IN OBESITY.

As in the care of cases of pinguidity, the ordinary consumption of food should be noted and a ration established. While it is interesting from the scientific standpoint to note the exact intake and outgo, it is clinically sufficient to estimate the ingesta from diet tables (See Chapter II) and to neglect the CO_2 and H_2O eliminated, though the simplicity of approximate methods of quantitating nitrogenous waste should lead to their estimation as a matter of routine and the physical integrity of the various emunctories should be investigated.

TREATMENT BY REMEDIES AND WITHHOLDING WATER.

Thyroid extract, phytolacca and other remedies proposed for the treatment of obesity have not given practical results in the writer's experience. Withholding water naturally leads to an immediate and quite rapid loss of weight but it is fat, not water, that is ultimately to be removed, though some obese patients are in a state of general pulpiness of tissues not deserving the term dropsy, and yet calling for a diminution of water. Especially in lithemic and nephritic cases, elimination depends upon a comparatively free use of water and, in general, neither oxidation nor elimination can take place except in the presence of a reasonable amount of diluent. Approximately, the amount of water as such, allowing for the ordinary consistence of the ingesta, otherwise, should be from

500 c.c. for lymphatic cases to 2,500 c.c. for cases complicated with deficiency of nitrogenous elimination.

The marked corpulence of eunuchs and of some women at the menopause suggests that the fat-oxidizing ferment originates in the sexual glands and should be supplied by extracts but there is no clinical evidence either to support or to disprove this hypothesis.

TREATMENT IMPAIRING HEALTH BY LIMITED DIET.

Treatments depending on the production of indigestion, impaired appetite or nausea, as by acids before eating; of diarrhea or intestinal fermentation as by salines or yeast, respectively; or of a condition of semi-starvation, are entirely unjustifiable although reasonable control of appetite, refusal to stimulate digestion or to assist it artificially, the maintenance of a fair degree of looseness of the bowels and the satisfaction of appetite by food rich in waste matter, are allowable within limits.

All limited dietaries are to be viewed with suspicion and they will not be discussed here in detail. Of all the various schemes suggested in this category, perhaps the least harmful is to allow the patient to eat whatever he may choose at any one meal and in any desired quantity, but to limit him to this one viand. Such a course implies the greatest extremes of excess and deficiency of individual articles of nutriment but tends to secure an average assortment of proteid, carbohydrate and fat in any one week as well as a general deficiency of food. The meat cure is especially contraindicated in lithemic cases.

MANAGEMENT OF OBESITY.

The proper management of obesity must be based on the realization that the disease can no more be cured by starvation than can typhoid by antipyretic medication. To cut off fats and fat-producing carbohydrates is simply allopathy and is not even justified by empiricism. One could achieve just as good results by the homeopathic theory of administering pure fat alone, in minute doses. While a normal animal rapidly uses up its fat during starvation, the obese patient may actually die of gradual inanition and still remain fat. Just as boulimia may cause or maintain a state of leanness on account of the overstrain of the nutritive viscera, so obesity may depend on a lack of nutrition which prevents oxidation and elimination.

While elimination is so important a factor, nothing is gained by excessive stimulation of the bowels, the kidneys or the skin. All emunctories should be kept moderately active, but hydrogogue cathartics, daily Russian baths, diuretics, etc., will reduce strength much more rapidly than fat.

OXYGEN IN OBESITY.

It must also be remembered that the mere introduction of oxygen does not necessarily mean increased oxidation. Oxygen-liberating chemicals can introduce only insignificant amounts. Respiration of pure oxygen fails because the body can secure all that it needs from the ordinary 20 per cent dilution in air and a concentrated gas simply means lessened depth or frequency of breathing. Neither can more oxygen be introduced by voluntary attempts to breathe more frequently or more deeply. Oxidation can be favored by exercise, including or substituting massage, according to the inability of the patient to take active exercise, especially on account of the condition of the heart and vessels. The lymphatic circulation undoubtedly has something to do with the deposition and removal of fat. The movement of the lymph stream can be accelerated by exercise and massage and the activity and number of the cells can be modified somewhat by friction, cold spinal douches, etc. But these means of increasing oxidation sometimes increase the appetite and assimilation of fat.

Unfortunately, the analogy between obesity and diabetes holds good with regard to prognosis also, though the results of the former are not so serious as concerns life. Still, it is better to recognize the limitation of our therapeutic ability than to undermine the general health by futile attempts which are in the nature of starvation.

A CASE IN ILLUSTRATION.

The following case record is given somewhat in detail to illustrate the compatibility of obesity with insufficient diet and the occasional need of increasing the ration, rather than of still further diminishing it.

Miss H. B., aged 21 to 22, height 5 feet ¾ inch, weighed 180 pounds in March, 1901, 164 pounds in June. From this time the weight had fallen slightly.

Date.	Length of Period in Days.	Per Diem Averages of			Weight, Pounds.
		Proteid.	Fat. (grams.)	Carbohyd.	
April 3	6	39.00	40.00	50.00	150
April 10	7	47.5	53.00	45.00	...
April 18	8	51.97	54.79	81.77	...
April 27	9	40.7	36.00	67.4	...
May 4	7	39.47	21.32	78.67	...
May 10	6	57.24	58.73	103.04	...
May 16	6	56.03	31.45	88.56	...
May 23	7	42.4	20.11	34.03	...
May 30	7	37.66	20.51	66.35	...
June 5	6	53.49	14.15	74.87	146
June 13	8	25.11	10.48	66.19	...
June 20	7	32.54	11.46	76.74	...
June 26	6	32.45	15.68	65.51	147¾
July 4	8	16.55	4.82	54.45	...
July 20	16	31.42	15.33	76.65	150

To these numbers must be added a slight amount for nutriment in fruits—except bananas, which are included—beverages and butter, which was used very sparingly. This patient taught school and walked from one to five miles daily, on a diet seldom exceeding half the theoretic requirement of proteid, averaging less than half the requirement of fat and only about a sixth of the requirement of carbohydrate and yet she remained 20 to 30 pounds over weight.

LEANNESS.

Emaciation due to disease or to obvious deficiency of nourishment requires no discussion. Many supposedly normal individuals, especially of the poorer classes, habitually eat too little and, occasionally, when poverty does not exist, there is a continuous lack of appetite not assignable to any abnormal condition, though itself abnormal. Persons living in solitude, those compelled to cook their own food and those who, for one reason or another, enjoy no adequate variety of food, as certain health cranks and their victims, often lack the normal incentive to appetite, though not limited as to amount of nutriment. Continuous exposure to cold and physical exercise may render the demand for oxidation of calorific food in excess of ordinary standards and, apparently, much of the leanness of young women is due to insufficient underclothing in winter. Aside from discoverable causes, there is also an idiosyncratic tendency to leanness, just as to relative obesity, and this tendency is markedly hereditary.

The relief of leanness is usually sought for cosmetic purposes and only incidentally does the need of nutriment of bone, fibrous tissue, viscera and muscles enter into the problem. Sometimes the endeavor to force nutrition impairs the digestive powers, whether undertaken by the patient himself or whether cod liver oil and similar tonics are urged by physicians.

DIET IN LEANNESS.

As in the case of obesity, complicating factors should be investigated and the weight and customary diet should be recorded. Exercise and heat radiation should be controlled, so far as possible, and the diet should be established with regard to the physiologic standard, but in the present instance there should be a moderate excess of fats and carbohydrates, instead of a moderate deficiency. Any food taken as a matter of duty and especially if distasteful, is more likely to aggravate the condition than to improve it. For this reason cod liver oil is seldom applicable. The exercise and recreation should be so planned that the patient will go to the table hungry. It may be advisable to add a late evening meal or a luncheon of light and easily digested food between two of the principal meals. Early rising should be rather discouraged and, if possible, nine hours' sleep should be taken. Cream, considerable amounts of butter, salt pork, bacon, mayonnaise dressing, etc., are appetizing forms of fat. Chocolate allows the introduction of ten or twenty grams additional. Starches and cereal foods and sugar or candy and sweet desserts should be employed but such foods should not be taken between meals. Gelatine puddings with whipped cream or fresh or preserved fruit, similarly served, increase considerably the caloric value of the diet. Quiet recreation in the open air is useful to stimulate the appetite without consuming calorific food.

CHAPTER XV.

RELATION OF METABOLIC ABNORMALITIES OF CARBOHYDRATE, FAT AND PROTEID.

Theoretically, each of the three organic foods may be affected by excessive and deficient degrees of catabolism. Deficient oxidation is represented, respectively, by diabetes, genuine obesity and the so-called lithemic or, possibly, uric acid diathesis. Some of the difficulties of classifying the last condition will, however, be pointed out later. Excessive oxidation of carbohydrates and fats does not occur as a genuine disease, though variations in appetite and in the ability to dispose of these foods indicate that not all persons have the same catabolic power. Leanness also probably often indicates such a condition especially with regard to fats. Excessive oxidation of proteids has been alluded to as an almost inevitable complication of diabetes mellitus. It also occurs in some cases of diabetes insipidus, though the majority consist simply of an excessive discharge of water in the urine. It is altogether likely that vague cases of lack of strength, muscular or nervous, including depression of various functions, are due to excessive oxidation of proteid from the tissues while the variations in the amount of proteid consumed, not merely ingested, undoubtedly correspond to individual differences in proteid catabolism.

CAUSES OF DISPROPORTIONATE OXIDATION.

In the practical consideration of these conditions, in general, we must attempt to distinguish among three sets of causes of disproportionate oxidation. 1. Excess or deficiency of intake, including both ingestion and assimilation. 2. Excess or deficiency of output on account of the condition of the emunctories. 3. Excess or deficiency of oxidation. The first set of causes must be determined by measuring the ingestion and studying the processes by which nutriment is rendered available in the blood. Glycosuria, pinguidity and "rich man's gout" are mainly due to this set of causes, as opposed to true diabetes, obstinate obesity and gout in the ill nourished. The second set of causes afford no difficulty of diagnosis in regard to carbohydrates and fat whose waste products are water and carbon dioxid. Obviously, there are respiratory and circulatory diseases which interfere with the proper elimination of carbon dioxid and therefore result in cyanosis. But such conditions are easily distinguished from failure of oxidation as a cause of lessened discharge of carbon dioxid while a hyperanthracemia from production of carbon dioxid more rapidly than it can be disposed of by normal emunctories is purely imaginative.

In diabetes, and possibly in other conditions, there may be an accumulation in the blood of non-nitrogenous substances which represent incompletely oxidized carbohydrate and fat although it is doubtful whether acetone, diacetic acid, beta-oxy-butyric acid, etc., are of this origin or whether they represent the non-nitrogenous portion of a proteid or other nitrogenous molecule. At any rate, in ordinary conditions of metabolism, we have no physiologically or clinically demonstrable intermediate products between fat and glucose on the one hand and carbon dioxid and water on the other.

Nitrogenous catabolism, however, is much more complicated and intermediate products of oxidation are always in evidence, even physiologically. Indeed, the nitrogenous moiety of the molecule is never more completely oxidized than urea for proteids and, according to recent teaching, than uric acid for non-proteid nitrogenous substances. Moreover, while the end product of oxidation of hydrogen—water—is absolutely non-toxic and that of carbon—carbon dioxid—practically so, except in accumulations sufficient to interfere with interchange of gases, even urea and uric acid are somewhat toxic of themselves. Again, except in the case of lesions of the circulatory and respiratory organs which have a direct mechanic influence on the interchange of gases and in various conditions which prevent the elimination of water so that it becomes mechanically burdensome, the elimination of the oxidation products of carbon and hydrogen rises or falls with the amount present in the blood. On the contrary, the end and intermediate products of nitrogenous oxidation may accumulate in the blood to an excessive degree, from purely functional disturbance of the kidneys and when there is a hyperazotaemia from whatever cause, and of whatever exact nature, there results a condition of direct poisoning quite different from the effects of hydraemia, which are purely mechanic and from those of hyperanthracaemia. Indeed, it is questionable whether there is really any such thing as carbon dioxid poisoning, the system suffering not so much from the toxic action of this gas as from lack of oxygen and the fact that osmosis of oxygen occurs more slowly as carbon dioxid accumulates.

The practical deduction from these considerations is that, while it is usually easy to distinguish essential suboxidation of carbohydrates or fats from accumulations of the parent substances on account of excessive intake or from accumulations of carbon dioxid due to deficient elimination, it is frequently and, perhaps usually, impossible to draw a clean cut distinction between accumulations of nitrogenous waste due (1) to excessive intake, (2) to essential suboxidation and (3) to deficient elimination. On the contrary, two or three of these conditions are often combined and they then interact in a vicious circle.

CHAPTER XVI.

DISEASES OF NITROGENOUS METABOLISM AND EXCRETION, RENAL AND URINARY DISEASES.

UREMIA.

Simplest of this group is uremia, which is not strictly a metabolic disease, but due to the retention of waste matters on account of actual renal disease or marked suppression of function. Uremia should be understood in its old sense of urinary toxic matter in the blood, and not in any special sense of incriminating urea which is only very mildly toxic and which may even be employed as a diuretic in uremia. The most careful investigation, notably by Bouchard, has failed to bring our knowledge of the subject to a focus on any one urinary constituent. Bouchard found ammonia, potassium, the alloxur bodies, urinary indican and its congeners possessed of more or less toxic properties, but no one of these represented fully the influence of uremia.

Rachford and Crane, *Medical News,* experimenting on mice, have found the sodium and calcium salts of the urine practically non-toxic. Ammonium salts are most toxic, potassium salts about half as much so, magnesium salts very mildly toxic until an amount is reached when they equal or exceed the poisonous effects of ammonium salts. The ordinary inorganic and organic acids normally playing a part in bodily chemistry—such as chlorids, sulphates, phosphates, acetates, etc.,—were possessed of little toxic power in combination with the bases mentioned, but oxalates and chromates, etc., were found markedly poisonous. Rachford's experiments with urine from patients with migraine, which is commonly considered to be a result of lithemia, incriminated especially the xanthin bases, his experiments being conducted with amounts of urine containing much less than the toxic dose of either ammonium or potassium.

CHOLEMIA.

Corresponding to uremia, is the still vaguer conception of cholemia—which must not be confused with the circulation in the blood of biliary pigment in jaundice—referring to a failure of that function of the liver by which intermediate products of proteid—and nuclein?—decomposition are changed to urea and perhaps to other nitrogenous waste matters, which are excreted by the kidneys. Aside from this action of the liver preliminary to renal excretion, we have a small amount of nitrogenous secretion or excretion in the bile, comprised in (1) all the biliary pigments which are apparently merely excreted by the liver, being formed in the spleen from hemoglobin and representing hemoglobin minus iron; (2) sodium salts of glycocholic and taurocholic acids, which are secretions in both senses, being somewhat useful and being formed by the hepatic cells; (3) various other nitrogenous waste, not well understood. While it has been calculated that suspension of the hepatic function for nine hours would cause death, as compared with twenty-four hours of urinary suppression, catabolism being supposed to proceed normally (Bouchard), cholemia almost never reaches a stage comparable to uremia in clinical manifestation; milder forms are characteristic of hepatic cirrhosis and the dietetic management will be discussed under the Liver.

SUPPRESSION OF URINE.

As is well known, suppression of urine may be recovered from even after a lapse of a week or more. Some elimination of urinary poisons takes place through the gastric and intestinal membranes, perhaps the liver takes on more of an eliminative than a preliminary function and, undoubtedly, catabolism is at a minimum. The dietetic indications are to reduce or absolutely to stop feeding, to administer hot saline solution, preferably by the bowel, to get the local effect of heat on the kidneys and, if alimentation should, for any reason, seem imperative, to use inunctions of fat, carbohydrates by the stomach, bowel or subcutaneously, and to limit the proteids to those of milk.

RENAL DISEASES.

An intelligent supervision of the diet in renal disease must not overlook the general nutrition in the attempt to spare the kidneys. Dropsy, cardiac and vascular changes, functional or organic, and toxemia, may be either systemic or renal in origin, or both. Renal function can be judged only vaguely by general conditions, and we must depend for attempts at quantitative gauging mainly on the examination of the urine. It should not be less than 500 c.c. nor more than 1,500, except transiently, in the twenty-four hours. Albumin—and globulin, which usually accompanies any considerable amount of albumin—is almost never excreted in sufficient quantity to draw seriously on the nutrition. Rarely, however, 30—50 grams may be lost in a day. An increase of albumin, casts, etc., should lead to an investigation of the diet, among other possible causes of exacerbation.

According to Van Noorden, acute nephritis and acute exacerbations of chronic conditions, are marked by imperfect elimination of urea, creatinin, coloring matter, phosphates, inorganic sulphates and potassium. Uric acid, hippuric acid, xanthin bases, aromatic substances, ammonium salts, amido-acids (*sic,* in spite of statement about hippuric acid, which is amido-benzoic acid), on the other hand, are well eliminated.

In the ordinary forms of chronic nephritis, normal waste matters are, on the whole, well eliminated. However, urea, inorganic sulphates, uric acid, and foreign substances like lead, arsenic, iron, iodin, bromin, boric acid and alkaloids, are held back. In a case of chronic interstitial nephritis with mitral obstruction and pneumonia, the writer found a general reduction of solids, especially of sodium chlorid, which was reduced to about one gram in twenty-four hours, instead of ten grams. Reduction of chlorids is said to be characteristic of pneumonia (pneumococcic infection), but it was considered in this case that salt was to be increased in the diet. Sulphates and phosphates are present in all mixed dietaries in sufficient amount. It is difficult to regulate them except by medicinal administration.

DIET IN BRIGHT'S DISEASE.

In general, the following rules may be laid down for feeding in Bright's disease. Water should be given in standard amount, as discussed in Chapter I. Occasionally, in chronic nephritis, it is well to flush the system by drinking copiously or by lavage of the stomach or bowel. A tendency to dropsy is an indication for reducing water, but not to such a degree as to cause spontaneous precipitation of urates, for there must be enough available in the system to provide for the solution of waste matter, and the body will not always utilize dropsical fluid.

Sufficient has been said as to salines. In chronic nephritis, especially of the interstitial type, the organic foods should correspond nearly to the demands of a healthy individual, not engaged in active exercise. Von Noorden limits the proteids of a female patient to 100 grams, of a male to 110, which is in accordance with this general principle, the sexual difference being mainly on account of weight and habits of exercise. Contrary to the prevalent belief, he holds that the albumin of light and dark meat of fowls, of animal muscle, fish, eggs and vegetables is practically identical. However, animal viscera, meat extracts, tea, coffee and chocolate and other sources of purin bodies (vide infra) and all substances liable to upset the digestion and to cause gastro-enteric fermentation or putrefaction, should be avoided.

URIC-ACID DIATHESIS.

Another group of diseases is due rather to faulty catabolism than to failure of elimination, though the latter is liable to be deficient, partly on account of the functional inability of the kidneys and liver to deal with excessive quantities of intermediate nitrogenous waste matters, partly because renal and hepatic disease is very apt to occur. This group of diseases—or perhaps it would be more correct to say *this disease* in its different degrees and manifestations—includes gout, lithemia, asthma, not due to obvious reflex causes, or local irritation in the respiratory passages, and eczema, not explicable as a local phenomenon. The term *uric acid diathesis* or the mongrel word *uricacidaemia,* has been applied to the whole group and, with certain changes of conception of the exact chemistry involved, this designation may be allowed to stand until more definite information is obtainable. Uric acid itself is not especially toxic, yet deposits of urates and an excess of uric acid in the blood certainly do exist in typic gout and in, at least, some cases of chronic rheumatism and other lithemic conditions, as well as in acute rheumatism, notwithstanding the evidence that acute rheumatic disease is of microbic origin.

THE PURIN BODIES.

More toxic than uric acid is the xanthin group including xanthin, hypoxanthin, paraxanthin, hydroxanthin, guanin, adenin and guaranin. Altogether, these amount to about 0.1 gram a day, in the urine, or to about a fifth of the amount of uric acid. With uric acid, they have received the designation of alloxur bases, which is at present out of fashion, and supplanted by the term purin bodies, whose exact definition seems to vary somewhat with different chemists. Purin itself is a derivative of nuclein and is not found in the urine—unless possibly, exceptionally. As clinical estimations of uric acid include the various purin bodies, and as there is no doubt that these substances in the aggregate produce the symptoms of the group of diseases due to nitrogenous catabolism of a faulty nature, it is not so much a difference of conception as of exact terminology, whether we speak of uric acid in the inexact clinical sense, of alloxurs or of purins.

UREA AND URIC ACID NOT COMPLEMENTS.

In a general sense, it is correct to classify these diseases as due to suboxidation, but the older notion that uric acid and its congeners represent proteid which has not been completely (i. e., in the physiologic sense) oxidized into urea, must be abandoned, as all of this class is held by chemists to be derived from nuclein, a non-proteid, but nitrogenous substance due to nuclear activity. Thus, except in a purely algebraic sense, we must drop the idea of ratio between urea and uric acid or other purin bodies, as the two are derived from entirely different sources and are not complements of each other. At the same time, we cannot overlook the clinical fact that when the purin bodies are increased, urea is rather apt to be decreased, but this may be due entirely to a concomitant failure of oxidation, digestion or even of ingestion.

THE ELIMINATION OF PURIN BODIES.

The remaining organic nitrogenous constituents of the urine are hippuric acid, which is an amido compound of benzoic acid and which seems to represent merely the excretion of benzoic acid introduced with food of a vegetable nature and is, therefore, of no clinical significance; and creatinin, formed by the abstraction of a molecule of water from creatin of ingested muscle and, possibly, from muscular waste in the body.

The elimination of uric acid and other purin bodies is quite easily and fairly accurately estimated by the centrifugal methods of Dr. R. Harvey Cooke, of Oxford, Ohio, or by a sedimentation method, on the same principle, devised by Dr. I. Walker Hall, of England. Phosphates are first removed and a gelatinous precipitate of silver-purins is formed by adding an ammoniacal solution of silver nitrate, to prevent the joint precipitation of silver chlorid. It is important to distinguish between exogenic purins and those due to tissue change within the body. The former should be largely eliminated from the diet in this class of diseases. Eggs, milk and its derivatives, bread, tapioca and, in general, the purer forms of carbohydrate and fat, as well as comparatively innutritious vegetables, may be given freely in the absence of special contraindications.

There is, as yet, no reliable clinical method of estimating purins in the blood, though we may consider them as excessive if crystals of uric acid form along a thread. With the clinical picture of gout, lithemia, etc., granted that the manifestations are not due to lactic acid or some other result of fermentation, the indication remains the same, whether the elimination of purins, on a purin-free diet, is normal, deficient or increased, as we wish to clear them from the blood as rapidly as possible and to stimulate the function of the liver in the preparation of nitrogenous waste and that of the kidneys, in removing it. From the standpoint of dietetics this amounts practically to increasing the water and the diuretic and laxative fruits.

DIET AGAINST EXOGENIC PURIN BODIES.

Exogenic purins are readily avoided by consulting the analytic table of I. Walker Hall. It should be remembered that animal broths and soups, though containing a small percentage of purins, introduce no compensating amount of genuine food, and they should be avoided. It is also possible, though not established, that gelatin, mucin, keratin, etc., also yield purins.

Chittenden has shown that the various purins are eliminated with unequal rapidity and that free purins are more rapidly changed and eliminated than nuclein. Still, it is well to avoid cheese, which contains nuclein, though not purins, and which is likely to set up fermentation and to embarrass the hepatic function. He considers that each individual has a nearly constant degree of cellular activity, so that the standard of purin elimination is an idiosyncratic constant, but this statement cannot be taken to refer to conditions of suboxidation of nitrogenous substances, as well as to health.

QUANTITIES OF PURINS IN MEATS, VEGETABLES AND BEVERAGES.

Walker Hall, Bristol Med. Jour., June 14, 1902.

	Undried Purins. Grams per Kilo.
Fish—	
Cod	0.582
Plaice	0.795
Halibut	1.020
Salmon	1.165
Meats—	
Rabbit	0.970
Tripe	0.572
Mutton, Australian	0.965
Veal, Loin	1.162
Pork, Loin	1.212
Pork, Neck	0.567
Ham, Fat	1.155
Beef, Ribs	1.137
Beef, Sirloin	1.305
Beef, Steak	2.065
Beef, Liver	2.752
Sweetbread (Thymus)	10.063
Chicken	1.295
Turkey	1.260

Cereals—	Quantity Used.	Gms. per Kilo.	Gms. per Liter.
Bread (white)	500 Gm.	no trace	
Oatmeal	250 Gm.	0.530	
Rice	500 Gm.	no trace	
Pulses—			
Peameal	250 Gm.	0.390	
Beans (haricot)	500 Gm.	0.637	
Roots and potatoes	1000 Gm.	0.020	
Tubers—			
Onions	250 Gm.	0.090	
Tapioca	250 Gm.	no trace	
Green Cabbage, Large head		no trace	
Vegetables—			
Lettuce, Large head		no trace	
Cauliflower, Large head		no trace	
Asparagus (cooked)	700 Gm.	0.2150	
Beers—			
Lager Beer	1000 Cc.		0.1250
Lager Drink	1000 Cc.		0.0500
Pale Ale	1000 Cc.		0.1450
Porter	1000 Cc.		0.1550
Wines—			
Claret	500 Cc.		
Volway	500 Cc.		
Sherry	500 Cc.		
Port, Commendador	500 Cc.		

URINARY ABNORMALITIES OF A CHEMIC NATURE.

Disregarding the indication of toxaemia, urinary abnormalities are of danger, mainly from the tendency to the formation of calculi and the irritation of the urinary passages with the resulting predisposition to inflammation. Incontinence and irritability of the bladder are often due to chemic abnormalities of the urine.

The amount of urine should be kept within normal limits, 1,000-1,500 c.c., mainly by the regulation of the water ingested. Sugar and salines in excess, as when too liberal amounts of fruits and vegetables are ingested or when much candy is eaten, are diuretic. The happy medium should be maintained between urine that is troublesome by its volume and that which is irritating or which tends to precipitation on account of concentration. The average capacity of the bladder and the average elimination of urine for the average period of sleep—eight hours—unfortunately are quite equal, so that the sleep is likely to be interrupted to empty the bladder or seminal emissions or incontinence of urine follow the reflex irritation.

English writers strongly emphasize the point that the nocturnal elimination of urine is normally less than during the waking hours and a reversal of this condition is considered an indication of beginning Bright's disease. While this symptom is worth considering, in regard to diet as related to nephritis, the writer is convinced that the custom of taking the heartiest meal of the day in the evening and the frequent indulgence in late lunches, with such diuretic beverages as chocolate, tea, coffee and beer, or even the free use of fruit and water during the evening, logically compels the kidneys to be active at night. Some persons form the habit of rising to pass water at night, almost or quite without breaking their sleep. The obvious regulation of the supply of food, water and other beverages will, however, do much to render this mild form of somnambulism unnecessary.

The reaction of the urine is usually acid, but it may be alkaline during the secretion of hydrochloric acid by the stomach or on a diet free from meat and rich in vegetable products. The writer's observations have rarely demonstrated an absolute alkalinity during gastric digestion, in spite of the teaching on this subject. Very little definite information is available regarding the normal acidity of urine. The writer uses the simple method with decinormal sodium hydrate solution and phenolphthalein and finds the usual acidity to be about 50—75 per cent. A higher acidity than this, not readily reduced by withholding meats and using vegetables and fruits, whose acids are converted into carbonates, or by increasing the volume of water, requires alkaline treatment.

There seems to be no local indication for altering the ordinary inorganic constituents of the urine.

A heavy precipitate of urates is, usually, no clue whatever to the amount of uric acid or other purins excreted, and it means concentration of the urine or cooling after voiding. At the same time, the persistence of a uratic sediment with a high acidity and diminution of volume, does threaten the deposition of calculi, and the means already discussed to counteract these conditions should be enforced. *A fortiori,* should the urine be rendered watery and alkaline if a uratic calculus has already been formed. Exactly the opposite course of treatment in regard to meats and vegetables should be carried out if a calculus, phosphatic, or possibly carbonate, has developed or seems imminent from the persistent alkalinity of the urine, but the bulk of urine should be kept large in all such cases.

CAUSES OF OXALURIA.

Little is known of the conditions underlying oxaluria which may culminate in the deposition of a calculus of calcium oxalate. Most urines form the characteristic crystals of calcium oxalate after standing, probably due to some form of fermentation outside the body. Oxaluria has long been connected, clinically, with intestinal fermentation, the dietetics of which have already been considered. Klemperer states (Zeitschrift für Klinische Medicin, 1902) that the most favorable condition for preventing the precipitation of oxalates is the presence in 100 c.c. of urine of at least 20 milligrams of magnesium oxid and not more than the same amount of calcium oxid. The former requisite is maintained by administering two grams of magnesium sulphate daily, the latter by avoiding spinach, tea, coffee, milk, eggs and fresh vegetables. It is obviously undesirable to restrict the diet in this way in many cases and it is, in general, very difficult to attempt to avoid calcium, with regard to urinary calculi, biliary calculi, calcification of the blood vessels, or any other condition. At the same time, it may be advisable to avoid auxiliary foods and vegetables of little nutritive value if their ash analysis reveals the presence of large amounts of lime.

The other ordinary constituents of urine, normal or abnormal, are either too little understood for discussion here, as cystin; or the indication for dietetic management is more important from other standpoints, as in the case of sugar, albumin and indican; or dietetics have little direct influence, as in the case of hemoglobin and biliary pigments. Aromatic substances such as balsams and spices, foods liable to faulty digestion and the production of vegetable, or amido, or fatty acids, alcoholic beverages and purin-containing foods are generally contraindicated in all except chronic inflammations of the urinary tract. In the latter the mild irritation of excreted spices and the indirect stimulation of alcoholic beverages may be useful.

CHAPTER XVII.

FEEDING IN FEVER, CONDENSED NUTRIMENT, EMERGENCY FEEDING.

While, theoretically, a febrile condition indicates increased oxidation within the body, the actual increase of combustion of foods and tissues, is not so great as might be anticipated. This is due to the lack of mental and physical exercise and to the usual absence of perspiration, whose evaporation is much more important in the dispersion of heat than the radiation, even from an overheated skin. Moreover, the psychic depression of appetite and the diminished innervation of the digestive glands and musculature, render it impossible to administer a normal quantity of food. Very rarely, is it necessary to decrease the amount of food voluntarily taken; on the contrary, the appetite and the digestive power, must be stimulated.

AMOUNT AND KIND OF FOOD IN FEVERS.

Speaking generally, one must steer between the Scylla of starvation and the Charybdis of injury from the amount or kind of food ingested, even excluding foods that are intrinsically uninjurious under ordinary circumstances. In fevers of less than two weeks' duration, the danger of insufficient nutriment may usually be disregarded, unless the patient is already in a state of depraved nutrition. In fevers of longer duration, to which the term *continued* is applicable, and of which, typhoid is the common illustration, it is necessary to force nutrition from the beginning, in order to obtain sufficient momentum to overcome the obstacles to recovery. In fevers with definite lesion of the alimentary canal and its tributary glands, the most careful attention is necessary to insure digestion without local injury.

What is to be said as to these conditions, including typhoid fever, applies with less strictness, to fevers in general. In all fevers, however, there is usually a depression of secretory and motor power, an increase of bacterial activity within the intestine, a greater susceptibility to gastro-enteric intoxication, as well as an obvious failure of appetite. Yet in fevers with no local lesion in the digestive apparatus, so long as a particular article of food is relished by the patient and it is nutritious and devoid of definite harmful properties, it should usually not be interdicted and there is no universal indication for liquid diet. The juicy fruits are valuable in introducing water and salines, which are diuretic, diaphoretic and laxative. Even in typhoid, orange, lemon and pine apple juices are fully as useful as the old fashioned fever mixtures of nitre and an acetate or citrate, and they are antiscorbutic. In the absence of diarrhea, or gastric disturbance, these fruit juices may be given almost ad libitum.

FREQUENCY OF FEEDING IN FEVERS.

The frequency of feeding is an important question and one about which there has been the greatest divergence of opinion, save only for the general agreement that the meals should be more frequent than in health. From our definite knowledge of the condition of the stomach after test meals, it may be positively asserted that at least two hours is required for the passage of the lightest practical meal, except a non-coagulable liquid, through the pylorus. It is clearly unwise to interrupt the digestive process by the introduction of fresh food, or even to keep the stomach continuously occupied. Thus, theoretically, as well as from the result of practical experience, we may state that the meals should not be given oftener than every three or four hours. On the other hand, as will appear later, if we exceed the four or five hour interval, it is difficult to introduce sufficient nutriment without overtaxing the capacity of the stomach, on a milk or analogous diet, or without exceeding the limits of the appetite and the power of the digestive glands to deal with the food.

CONDENSED NUTRIMENT.

It may not be inappropriate to discuss, at this point, the popular and, to a certain degree, the professional, misconception of "condensed nutriment." The average requirement of the sedentary but healthy adult, is not much less than 600 grams of dry food, organic and inorganic (see Chapters 1 and 2). While little of this is of high specific gravity and the fats are notably lighter than water, these 600 grams correspond to at least 500 c.c. Thus, the "pill containing the condensed nourishment of a meal," which writers of fiction describe as being carried in the vest pocket of the man of the future, is easily calculated to be a sphere of between six and seven centimeters, or, say, 2½ inches in diameter. No power on earth can compress fat, pure proteid, starch or sugar, and the various mineral salts into a smaller compass. But, for practical purposes, we must remember that none of our so-called dry foods, are absolutely water free. Bread, for example, contains nearly 40 per cent. of water; cooked meat, 60 per cent.; ordinary nutritious vegetables, such as the potato, 70-90 per cent., the average of solid food, being about 50 per cent., so that the daily ration of solid food amounts to 1,000-1,500 grams or c.c. At the same time, we both must and can maintain a quiescent patient for a long time on very much less than the standard of nutriment, metabolism falling as the diet is reduced; and, indeed, the reserve of nutriment in the body has proved sufficient to support life for forty days, if water alone is allowed.

DIET IN FEVERS.

The aim of the physician in charge of a case of fever, or other protracted disease, should, nevertheless, be to attain as nearly as possible to the standard of 125 grams of proteid, 90 of fat and 450 of carbohydrate, on the hypothesis that the increased combustion of fever or the demand for tissue building and increase of functional power is approximately equivalent to the nutritive demand created by active labor. While milk and animal broths and extracts are usually fairly palatable and easily digested, the former is markedly deficient in carbohydrates and the latter in both carbohydrates and fats, while meat teas, prepared by heat and cleared of sediment are practically without nutritious properties, though possessed of some value as a stimulant. For combination with milk and meat extracts, which afford too little fuel food as compared with proteid, some form of cereal is desirable, because of the relative excess of carbohydrate and the adaptibility to formation of broths and milk. While dry bread or almost any of the breakfast foods may be used, provided that there is not too much grit or scale, crackers are especially convenient as they are usually well liked, an ample variety is available, they are nearly sterile to begin with and can be rendered almost absolutely so by toasting, which dextrinizes the starch. Crackers contain 90-95 per cent. of available nourishment, quite well distributed among the organic classes, as shown by the following percentage table from Clark:

Kind of Bread Stuff.	Water.	Proteid.	Fat.	Carbohydrate.	Min'al Matter
White wheat bread..	32.51	8.8	1.9	55.8	1.
Graham bread......	34.2	9.5	1.4	53.3	1.6
Rye brean..........	30.	8.4	0.5	59.7	1.4
Boston crackers.....	8.2	10.7	9.9	58.8	2.4
Soda crackers......	8.	10.3	9.4	70.5	1.8
Pilot "bread".......	7.9	12.4	4.4	74.2	1.1
Graham crackers....	5.	9.8	13.5	69.7	2.
Oatmeal crackers....	4.9	10.4	13.7	69.6	1.4
Oyster crackers.....	3.8	11.3	4.8	77.5	2.6

The number of crackers of any particular make, in a pound, is nearly constant and can readily be determined so that the estimation of nutriment, may be quickly made from a count. Thus, a pound of soda crackers, numbering 20, represents nearly fifty grams of proteid and fat, each, and 325 of carbohydrate. Five meals daily, each consisting of four crackers and a cupful of milk (250 c.c.) would represent this amount of nourishment plus about fifty grams of each class, aggregating very nearly the theoretic needs of the average healthy adult at moderate exercise.

TO SUPPLY VARIETY IN DIET.

Obviously, such a ration would become monotonous; but, by varying the kind of cracker, or substituting dry or toasted bread or some other cereal and by giving the milk cold, hot, frozen or combined with coffee or chocolate or with eggs, in the various forms of custard, we can secure a large variety. While the coffee adds practically no nourishment, an ounce bar of chocolate adds 15 grams of fat, 6 of proteid and 3 of carbohydrate, not to mention a few grams of sugar commonly used with it. Each egg adds 5 of fat and 8 of proteid. Sweetened gelatin or fruit jelly with whipped cream, sponge cake, angels' food, etc., may usually be allowed for one or two meals, if the patient desires.

The various beef extracts vary considerably in nutriment; Mosquera's beef meal contains 13 per cent. of fat and 77 per cent. of proteid; his beef jelly 53 per cent. of proteid, mostly in the form of peptones; somatose contains 90 per cent. of albumoses; expressed beef juice, about 6 per cent. of proteid and a small but variable amount of fat; other condensed extracts and proprietary foods may be used, according to the analyses furnished. Unfortunately, there is no official board to provide accurate analyses and those furnished by private parties are not absolutely reliable, even when published in good faith, as the nutrients of the raw material do not always appear in the finished commercial product. Beef teas and extracts of the Liebig type contain chiefly extractives which are stimulating, on account of the xanthin bases, but which are not strictly nutritious and which may be positively contraindicated, if there is already an accumulation of such waste matters, on account of hepatic or renal failure.

Fats may often be supplemented by the use of butter or cream but, if sufficient carbohydrate is readily taken, we need have little anxiety as to fats, as they may be almost dispensed with, on account of the power of the body to use carbohydrates and proteids vicariously and even to form fat from one or both of the other classes of food. Moreover, at least 25 grams of fat can be introduced by inunction daily, and a considerable percentage is contained in apparently fat-free foods.

DIET DURING CONVALESCENCE.

Especially after typhoid, the appetite is likely to be excessive and the utmost care must be exercised to guard the patient against relapse or even hemorrhage and perforation, as the result of overeating. In the writer's opinion, this condition is largely due to systematic starvation during the fever. A man who has been on a diet of milk and broths for five weeks is much more likely to have an uncontrollable appetite than one who has enjoyed some variety and an adequate amount of semisolid food for, say, four weeks. Due precautions must be taken against fermentation and putrefaction in the bowel and against mechanic injury to the recently healed ulcers, all in accordance with general principles already discussed in the chapter on the intestine. The physical and mental rest enforced during a prolonged fever quite often seem to have a beneficial after-effect;

at any rate, it is no uncommon experience that a delicate youth takes on flesh and increases in general health and strength, to a surprising degree, within a year after an attack of typhoid.

It will be noted that, in discussing the diet of typhoid (See also Chapter XX), there has been advocated for the febrile period, about the same list as has been advised by older authorities, for the first week or two of convalescence. If the strict liquid diet has been employed during the fever, there is no question but that one must add to it by an egg, a small piece of toast or minute portion of meat at a time. If the cereal and milk or broth diet has been used, one may increase it after defervescence, with less danger of relapse; but food containing notable quantities of cellulose, meat fibre, etc., should not be employed within three weeks of defervescence and the ordinary menu should be postponed for two weeks longer. Hydrochloric acid and vegetable digestants, as malt and the pawpaw extracts, should be used as indicated, to assist a weak digestion.

USE OF ALCOHOLIC LIQUORS.

The use of alcoholic liquors deserves special attention. It is now commonly taught that alcohol, as such, has no genuine stimulant action although, even in fevers, there may occasionally arise the necessity of relaxing an arteriole spasm. In such a state, what is pharmacologically a depression, amounts practically to a stimulation, for the ultimate condition is the same, whether the heart is embarrassed by its own weakness or by resistance in the arterial circulation. If the latter condition occurs, in very marked and acute degree, nitroglycerin or inhalations of amyl nitrite are needed. If the degree is less marked, alcohol is superior. But, while alcohol may be directly indicated in fevers, for its therapeutic effect, it has been greatly abused and many of the nervous symptoms seen under the old treatment, were those of intoxication.

On account of the relative susceptibility of the nervous system and the small dosage required to produce toxic effects, drunkenness is not uncommon at present, in infants, as the result of injudicious administration of alcoholic beverages. On the other hand, moderate amounts of alcohol should be continued in those addicted to the habit, as the system is accustomed to oxidize relatively large amounts and as the sudden withdrawal may precipitate delirium tremens as a complication of the fever. At the outset, it is a safe rule to administer about half of the amount usually taken, gradually reducing to a quarter at the end of a week, and to an eighth at the end of another week. This rule must be varied in accordance with individual symptoms.

Alcoholic beverages also have value as digestive stimulants, overbalancing the direct depression of the alcohol itself. Experiments have shown that the maximum stimulation of digestion by alcohol is reached when present in the proportion of 3 to 5 per cent. of the total food mass and that, when 5 per cent. is exceeded, inhibition of digestion is manifest. Thus, for a meal of 500 c.c., which is rather larger than the average for a fever patient, the amount of alcohol should never exceed 25 c.c., corresponding to about 50 c.c. of whisky or brandy or 125 to 150 c.c. of the various wines. This, it should be remembered, refers to the maximum percentage in a maximum feeding. While it has been shown that up to about 200 c.c. of alcohol may be administered in 24 hours without appearing as such in the excreta, this amount may cause nervous symptoms before it is oxidized.

It is a safe rule not to exceed a tablespoonful of whisky or brandy at a feeding, this amount corresponding to 7.5 c.c. of alcohol and forming approximately 3 per cent. of a feeding of fair size, say a cupful of milk and a few crackers. Even this amount should not be given as a routine, but only when needed to stimulate digestion. For infants, a drop or two is sufficient. While whisky is usually preferable, almost any form of the stronger alcoholics may be used and, unless the stomach is dilated or there is an excess of gas, champagne may be used. To some persons, alcoholics are positively distasteful and, in such cases, fruit juices may be used if appetizing and plain soda water instead of champagne. Soda water may be obtained in siphons or may be drawn from a fountain and bottled. Alcoholic beverages may be combined with egg and milk, in the form of egg nog, or with jellies.

During convalescence, beer and ale may be employed if desired, both as mild stimulants and nutrients, but the amount of maltose—or more likely, glucose—and proteid is relatively insignificant.

NUTRITION IN FEVERS AND OTHER CONDITIONS IN WHICH FOOD IS NOT READILY ADMINISTERED.

For the sake of convenience, it has thus far been assumed that there has been no notable failure of digestive power and no considerable degree of nausea. If undigested food appears in the feces, without marked failure of appetite or vomiting, the problem is fairly simple, as the digestive power can be reinforced by the simultaneous administration of digestants, preferably of pawpaw extracts, or by first pancreatinizing milk and similar foods.

PREDIGESTED FOOD.

The so-called predigested foods should be viewed with suspicion and untried "digestive" preparations should be tested. For example, a "digestive" wine prepared from pine apple, which certainly contains a valuable ferment, was found to be absolutely inert and many of the so-called peptones fail to show the characteristic lilac band with an alkaline copper sulphate solution. For practical purposes, artificial peptones are objectionable on account of their bitter taste and the accompanying toxins and we can, at most, administer albumoses. Predigested carbohydrate means, according to the degree of digestion, dextrin, maltose or glucose and it seems probable that cane sugar is as easily transformed as maltose by inversion into glucose. Yet, on account of cloying the appetite and irritating the mucous membrane, we cannot administer clear sugars in any amount and, for practical purposes, predigested carbohydrate simply means cooked and finely divided starch, partly dextrinized and with only small quantities actually digested into either maltose or glucose. Predigested fat, literally means glycerin plus soaps. There is much dispute as to the practical food value of the former while the impracticability of using the latter is universally recognized. Thus, we can go no farther than the emulsification of a fatty food and there is no proprietary or other artificial emulsion superior to good cream.

Thus, for practical purposes, the methods of predigestion at our command are very limited. If there is failure of hydrochloric acid, without marked deficiency of ferments—the usual condition in fevers—we may add the official dilute HCl (10 per cent. of the gaseous acid) to milk, milk and egg, etc., drop by drop till 3.5 per cent. is present, the amount necessary to combine fully with the proteid.

While, in theory, almost any form of animal or vegetable digestion may be imitated artificially, the only one at all commonly employed is the pancreatic, using a dry, alkalinized extract. Approximately, 1,000 parts of milk require 1 part of extract or "pancreatin" and about an equal amount of sodium bicarbonate. However, different extracts differ much in digestive power and a moderate excess does no harm. The most convenient preparation is the "peptonizing tubes," one of which is sufficient for a stated quantity of milk. The digestive process is carried on at body temperature for about 20 minutes, further digestion producing bitter peptones. The digestive process is then stopped by cold or heat, scalding to about 150° F. or cooling to 40° F. being sufficient.

ABNORMAL GASTRIC CONDITIONS AND NUTRITION.

In case of violent nausea and vomiting, persistent psychic objection to food, mechanic obstacles to swallowing or to the onward passage of food from the stomach, as in cancer of the pylorus, or any other condition which persists and prevents the taking of food in the normal way, we are relieved of considerable responsibility, as the indication in favor of nutrition by fistula, rectal injection, inunction, etc., is plain. The details of all such methods will be discussed in a separate chapter. It is the intermediate cases which neither present absolute obstacles to natural alimentation nor submit to an adequate ration, which cause the physician the most anxiety and subject him to the greatest responsibility. Such cases may be febrile, or otherwise, the stomach may be irritable from local lesion, such as cancer or catarrh, or from a reflex disturbance, as uterine disease, movable kidney, renal or biliary calculus or some vague disturbance of metabolism; or, as the result of some primary condition, there may be an abortion or premature delivery and an irritable stomach as a result of both the primary and the secondary condition. Sometimes there is no obvious cause for the lack of appetite or unrest of the stomach. Again, there may be an esophageal stricture that is not absolute. All of these and analogous cases present the same general indications from the dietetic standpoint: to introduce sufficient nourishment, to keep it down and to have it digested and absorbed.

This group of cases may be considered in three categories:

1. Those in which the first indication is the

principal one, and in which the problem is practically solved if we can introduce sufficient nutriment. Among the insane, gavage or feeding at the hands of an attendant must occasionally or, in certain cases, regularly be practiced. Sometimes the patient resists the introduction of food; sometimes the resistance is merely nominal or the patient may even report voluntarily for nourishment, but will not feed himself. The writer has seen a neurasthenic case—also syphilitic and showing signs of gastric catarrh, but with neither organic disease of marked degree—in which no food of any importance was taken for over a week. Treatment was almost wholly by moral suasion. Many patients will tolerate nourishment introduced by the tube in amounts which they can not or will not swallow. In other cases, the direct management of the case devolves upon a tactful nurse who is also a good cook and expert in preparing dainty dishes.

2. Cases in which attention must be paid both to the introduction and digestion of the food. Along with the administration of food, artificial digestants or predigestion must be considered and the condition of the digestive organs requires active treatment, local or medicinal. While it is beyond the scope of dietetics to discuss the latter indication in detail, it may be pointed out that the two or three hours

immediately following the administration of food is the time to force digestion and to use measures directed at the retention of food, while the interval remaining till the next meal should be used in treating the underlying digestive disturbance.

3. Cases in which absorption or assimilation fails, in the absence of direct failure of digestion itself, or in which the food leaves the body, imperfectly digested, in spite of every effort at securing predigestion or at adding artificial digestants and spurs to the digestive functions. These cases are usually malignant, or due to essential disease of the pancreas, or to functional failure of innervation, as in Addison's disease, pernicious anemia and other states not understood. Normally, the filtrate or watery extract of the feces should contain practically no carbohydrate nor proteid and neither fat, milk curds nor other wasted nutriment should appear macroscopically, except in tenden ends, tough meat and in vegetable foods having tough cellulose inclosures. In all doubtful cases, thorough chemic investigation of the feces, which are beyond the scope of clinical medicine, should be ordered. While the demonstration of such conditions should cause redoubled efforts to secure digestion and absorption, intrinsic and continued failure of these functions is beyond control, nor can even digestion alone be carried on artificially to a successful issue.

INDICATIONS IN THE VARIOUS INFECTIOUS PROCESSES.

While the general principles of feeding in fever are readily adapted to special infections, it may be well to consider briefly certain indications and contraindications commonly considered to exist in the various infectious processes.

Rocky Mountain Fever; Continued Fever (of doubtful nature), Dengue—Diet same as in typhoid.

Malarial Fevers, Exanthemata, Pertussis, Influenza, Febricula, Erysipelas.—From light, house diet, to that of typhoid, according to the severity, there being usually no local nor metabolic factors to demand special precautions.

Typhus, Bubonic Plague, Anthrax, Equinia.—On account of the grave disturbance of the system these require practically the same care as typhoid, while there is even greater need of supporting the strength by an abundance of nourishment. Egg-nog is a staple ingredient of the diet. If possible, 2,000 c.c. of milk and 4—10 eggs should be given in twenty-four hours.

Relapsing Fever.—Same as for typhoid, there being less urgency as to feeding on account of the brief course before the intermission, during which feeding should be forced so far as practicable.

Septicemia, Pyemia, Miliary Tuberculosis, require an abundance of easily digested food, not necessarily liquid unless the temperature is high.

Cholera and Yellow Fever often present considerable irritability of the stomach and upper intestine. Nutrient enemata may not be retained. Subcutaneous injections of saline solutions must be relied upon to a large degree and, theoretically, we have in these diseases, an urgent indication for subcutaneous injections of glucose. As soon as the rectum or stomach becomes tolerant, predigested foods should be administered.

Dysentery.—In tropical dysentery, the advocates of the ipecac treatment, emphasize the importance of avoiding all foods for at least three hours after administering the drug, although ice may be allowed. For the first day or two, milk alone should be given. Beef extracts, eggs, bread and other "light" foods, are said to be prejudicial to the action of the ipecac. After a few days, these may be given but solid foods are commonly interdicted for a week or more, or until the condition of the bowel is considerably improved. Many authorities prohibit solid food till the patient is convalescent.

The milder forms of dysentery, such as are seen in this country and perhaps including cholera nostras and infantum demand somewhat less arbitrary restrictions, as regards the kind of food. In the choleras, it is well to give no food for a day or two, unless the patient is threatened with inanition. Water and salt, preferably by enema or through the skin, may be employed to advantage. In infants who have been fed upon milk, many authorities regard the condition as essentially a milk poisoning, which probably is to be explained as due to the excessive virulence of certain bacteria, on account of the pabulum afforded by the milk. Thus, the indication is to administer egg albumin, beef juice, toast water and other vegetable gelatinous solutions, such as are obtained from barley. The prepared foods may also be employed temporarily. It is only fair to state that many authorities are sceptic as to the existence of anything that deserves the term milk poisoning and that, even when infection has apparently been due to milk from a certain source, they see no objection to feeding with milk, provided that it be of good quality. While the bacillus dysenteriæ has been isolated from the stools of typic cases of cholera infantum, we are not yet justified in considering all cases of cholera nostras—including cholera infantum—as genuinely dysenteric or as belonging to the group of specific fevers.

Mumps.—The inflammation of the parotid usually requires feeding with liquids, through a curved or bent tube.

Hydrophobia, and Tetanus.—The attempt at deglutition or even the reflex from intubation of the oesophagus or the insertion of a rectal tube, may excite a convulsion. The comparative rarity of both these diseases renders it impossible to formulate any definite rule as to the conflicting indications for absolute rest and for nourishment nor as to the best means for introducing nourishment. Sometimes, especially when there is a notable degree of spasm of the jaw, feeding by a nasal tube is preferable. In all cases, the nourishment should be bland, liquid or semiliquid and of the body temperature in order to excite as little reflex response as possible. Usually, the food should be predigested.

Cerebrospinal Fever.—Reflex convulsions may interfere with nutrition, as in the preceeding diseases. Tyson advises rectal nutrition for the first few days, using not over 120 c.c. at once. Heubner, on the contrary, advocates gavage.

Diphtheria.—To prevent the swallowing of infectious material, nourishment should be given immediately after a local treatment of the throat. The throat should be again cleansed immediately after the meal. The patient should then be allowed to rest as long as possible, considering the urgency of the local lesion, and should rarely be fed oftener than once in four hours. The nature of the food should be in accordance with general principles and rectal or other special modes of introducing nourishment should be used when indicated.

Beriberi.—While probably a parasitic disease, certain groups of cases have been ascribed, respectively, to fish and rice diet and it is well to avoid such articles of food, not only on account of the possibility of introducing fresh infectious material but because the limited diet may, very probably, have caused a relative deficiency of certain food materials. In general, the indication is for a simple, digestible but fairly varied diet.

Chronic infections, such as tuberculosis, syphilis, possibly the malignant neoplasms, actinomycosis, etc., require no particular limitation of diet, excepting during febrile exacerbations, if such exist. Local lesions of any of these processes, in the alimentary canal, may indicate various restrictions of diet, in accordance with principles already discussed. Certain authorities consider that the parasite of cancer—whose very identity and existence is still questioned—is introduced in raw vegetable food, which should, therefore, be avoided after early middle life. In general, the possibility of the introduction of specific microörganisms by food, is a matter of prophylaxis, rather than of diet. Febrile processes connected with local inflammations of various organs, whether due to specific, microörganismic cause, as pneumonia or gonorrhea, or to ordinary, non-parasitic irritants, require no special discussion, so far as diet is concerned.

MINIMUM RATION.

In attempting to feed patients who can retain and digest only small quantities of nourishment, it becomes of the utmost importance to determine on how little food life can be maintained and how much the patient is actually ingesting and absorbing.

The standard physiologic man, exercising actively, weighs 70 kilograms, excretes about 35 grams of urea by the kidneys (including as urea about 2 grams of uric acid and other nitrogenous matter decomposed by hypobromite solution and calculated as urea) and about 5 grams additional of nitrogenous waste by the feces, the excretion of nitrogen by the skin and lungs being too small to be measured. Thus, empirically and by comparison of molecular and atomic weights, we have the following progressive ratio: 70 kilograms weight of body: 40 grams total daily nitrogenous waste, calculated as urea and including both metabolic waste and wasted nutriment: 18 grams waste N: 110 proteid food: 550 grams lean meat. While 125 grams of proteid is usually allowed in diet tables, 110 grams is probably a full allowance, if an abundance of fuel foods are given.

In sedentary persons of fair health, we find the urinary nitrogenous waste, calculated as urea, reduced to 15 to 20 grams. Adding 1/7 for fecal nitrogenous waste, the total is raised to about 17—

23 or approximately 50 per cent of the standard and this total may be still further reduced, if the patient is notably under weight, though we must estimate what the patient would weigh if carrying an average amount of fat, for the latter, in reasonable amount, has no influence on nitrogenous metabolism. Allowance must also be made for deprivation of limbs and unusual heaviness or lightness of bones, weight of tumors, etc. No accurate means are available for these allowances. Granting that the patient, as standarized, is comparable to the physiologic man of 70 kilograms, we may conclude that, in a resting condition, with plenty of fuel foods, he may subsist on about half the normal amount of proteid, or approximately 50 grams.

In any given case, however, the proteid ingested should correspond to the total nitrogren eliminated, either as the result of metabolism or of failure of digestion. Bernert and Steyskal (Archiv für Experimentalle Pathologie und Pharmacologie, Vol. 48), have investigated the minimum albumin required for nitrogen-equilibrium in pernicious anemia and place it at 0.48 grams per kilo of body weight, corresponding to 30 to 35 grams for a person of average size. But this estimate is extremely low and scarcely applies to the nutritive demands of disease in general because, in pernicious anemia, the red blood cells, or rather, for present purposes, their power of carrying oxygen, is greatly reduced, much more so than in ordinary secondary anemia. In this connection, allusion may be made to a point that is often overlooked, namely the importance of administering a portion of the proteid in the form of meat or of such meat juices and extracts as contain notable proportions of hemoglobin. Expressed meat juice contains very little, as is indicated by its color and beef teas, prepared by heat, contain less than appears to be the case. Except for the psychic element which may often be overcome, fresh blood is an excellent food, while bovinine is practically a preserved blood. It is commonly stated that the hypobromite test as applied to urine, includes practically all nitrogen as urea but Dr. G. H. A. Clowes of the N. Y. State Cancer Laboratory at Buffalo, states that he has found the Kjehldahl estimation of total N to be almost exactly equal to the sum of the N obtained by hypobromite, and that contained in uric acid. Unless the patient is taking some preparation of ammonium, inorganic N may usually be disregarded. An excess of N in the feces usually indicates failure of digestion and absorption. Still, the trouble and expense of full determinations of N are often prohibitive and we may usually depend upon the hypobromite method as applied to the urine with the arbitrary addition of 1/7, provided that proteids are absent in the fecal filtrate or extract.

A PROTEID RATION INSUFFICIENT.

That a full proteid ration is not sufficient without an abundance of fuel foods, is well shown by two observations of Harley and Goodbody on persons confined to bed. A rather fat woman of 72 kilograms—corresponding to a standardized body of 50 to 60 kilograms—was placed for a week on a daily ration of a pound of mutton, containing 12.16 grams of N or about 75 grams of proteid and about 25 grams of fat. The total daily elimination was 13.51 of N, only 0.48 of which was by the feces, indicating a full utilization of the food and probably a deficient hepatic eliminative function. In the week she lost 9.45 grams of N, corresponding to 283.50 of lean muscle, the total loss of weight being 2,000 grams. A male patient lost, in four days, on the same diet, 32 grams of N, corresponding to 960 of lean muscle, with a total loss of weight of 2,000 grams; the difference between nitrogenous and total loss being, of course, mainly due to combustion of fat.

While the estimation of N, for a patient, simply involves trouble for the attendants and expense, that of C is impracticable, for 90 per cent. of CO_2 is eliminated by the lungs and this cannot be collected without subjecting the patient to an environment which is out of the question except for animal experiments and those voluntarily submitted to by healthy persons. In health, the total elimination of C is about 280 grams, that of N, 18, the ratio being easily remembered as 16:1. It is calculated from molecular weights that the ratio of C to starch is 2:4.5, of C to cane sugar, 2:4.75, of C to glucose 2:5. 51.5 to 54.5 per cent. of proteids, is C. Tripalmitin contains 75 per cent. of C; tristearin, 78 per cent. minus; triolein, 78 per cent. plus. The various fats consist mainly of these three substances, more or less mixed.

FAT AND CARBOHYDRATE IN MINIMUM RATION.

It is not possible to calculate mathematically the ration of fat and carbohydrate, on account of the fact that one may replace the other to a large degree. Then too, in disease, the combustion of fuel foods may be increased or decreased from the normal and, even in fevers, in which oxidation is theoretically increased, we can be by no means sure that the elevation of temperature really means an increase of heat units formed by oxidation. Moreover, the body has a store of fat which may be drawn upon and it is doubtful whether the indication is to provide for increased oxidation or to diminish temperature by withholding the ultimate source of heat, even if emaciation does occur more rapidly.

By making certain arbitrary assumptions, which are supported, to some degree, by experience, we may estimate the carbohydrate necessary. It has been shown that a minimum of 50 grams of proteid is required. An equal amount of fat may usually be administered, half being introduced by inunction, if necessary and part of the remainder being contained in meat, cereals, eggs, etc., ordinarily used as the source of proteid, or, if milk is used as the source of proteid, the patient receives approximately equal amounts of both fat and carbohydrate. Thus, in general, 50 grams of fat may be administered without the realization on the part of the patient, that he is receiving any fat at all. Fifty grams each of proteid and fat, represent 27 and 38 grams respectively, of carbon —a total of 65. In health, we have an additional demand for 215 grams of carbon, corresponding to 483.75 grams of starch. In a quiescent state, life may be maintained on half this allowance without drawing to any degree upon the store of fat. A loss of weight of 2 pounds a week, allowing for equilibrium of nitrogenous and watery intake and outgo, signifies the daily utilization of about 100 grams of body fat. Such a loss, which can be sustained for ten weeks by most patients, supplies about 76 grams of carbon additional and supplants about 170 grams of starch, so that if from 70 to 100 grams of starch or other carbohydrate can be given daily, the patient may be considered as free from any immediate danger of starving, always provided that the nutriment administered is actually assimilated.

DAILY EMERGENT RATION.

Thus, we may place the minimum emergent ration, for a quiescent patient, at 50 grams of proteid and fat, each, and 70—100 of carbohydrate. This corresponds to a quart of milk and five soda crackers daily, with a considerable margin in the way of carbohydrate or, still more closely, to a quart of egg nog, including two eggs and an ounce of sugar. Less than this ration is plainly inadequate and we can only comfort ourselves with the empiric knowledge that fairly healthy men have fasted forty days and have recovered and that under stimulation, by strychnine or similar drugs, and the use of hot saline solutions, even a very sick patient may vegetate for several days or a week or two, and still recover.

The plan of administering a teaspoonful or two of nourishment every half hour or hour, interrupts digestion, breaks the rest of the patient and tends to maintain a state of gastric irritability, even though the stomach may not immediately be able to relieve itself of such minute amounts. Two teaspoonfuls of milk an hour represents 240 c.c. a day, if no vomiting occurs and it usually does occur several times. This quantity contains only about ten grams of each kind of organic food. The same amount of 6 per cent. solutions of meat extract—the full proportion usually contained—represents about 14 grams of proteid but practically nothing else. It certainly is reasonable to suppose that patients recover in spite of, not on account of, such dietetic management.

CHAPTER XVIII.

DIET IN DISEASES OF THE ALIMENTARY CANAL—MOUTH, PHARYNX, ESOPHAGUS, STOMACH.

Traumatic and inflammatory conditions of the upper alimentary canal sometimes require a liquid or semiliquid diet free from chemically or mechanically irritating properties, but the indications are so clear as to need no discussion. The use of tobacco, irritating beverages, and of fruit, etc., contaminated with bacteria and fungi is often contraindicated by local as well as general possibilities of damage. Dentists, during attention to cavities, etc., must frequently advise care in regard to foods containing seeds or requiring mastication; but, from the medical standpoint, the indication is to provide as perfect a substitute as possible for the normal dentition and not to change the diet materially and permanently. At the same time, the proper care of the teeth always requires an avoidance of very hot and very cold ingesta and, especially, an alternation of extremes of temperature, which tends to crack the enamel.

THE ESOPHAGUS.

Stricture of the esophagus, whether accompanied by dilatation or not, necessitates the use of soft food or of liquids, without regard to the nature of the disease process. In acute traumatic conditions both mechanic, chemic and fermentative properties of the ingesta must be avoided if, indeed, feeding by mouth is allowed at all. In ulcerations of the esophagus itself or of adjacent lymph nodes, in cases of contiguous aneurysm or esophageal varices, mechanic irritants may cause rupture with, respectively, septic or hemorrhagic results that are likely to prove fatal.

In this connection, allusion may be made to the lodgement of foreign bodies in the esophagus. Death from asphyxia has occurred from the attempt to swallow whole crackers and huge pieces of meat. In the case of little children, and sometimes of adults, the physician may have to decide as to the possibility of an object of known size having been swallowed. Infants often manifest symptoms of pain and digestive disturbance after playing with marbles, buttons, etc., which can not be found and adults have at times given a distinct history of having swallowed a plate of teeth when the missing object is subsequently found not to have been in the mouth at all. In general an infant's esophagus will allow the passage of an object 8 or 9 millimeters in circumference, an adult's that of an object as large as 12 millimeters in circumference, but under extraordinary conditions, much larger bodies may pass and, so far as the writer knows, there are no reliable data on this point, which warrant the expression of a positive opinion.

When bone, fruit pits, metallic articles, teeth or dental plates or other objects having sharp points or edges, are swallowed, the indication is to feed with large quantities of coarse cereal foods, to administer pure mineral oil and laxatives.

STOMACH.

Under this heading will be considered, first, essentially functional conditions and then organic diseases, but it must be borne in mind that comparatively few gastric cases can be classified under one heading alone and, frequently, gastric and intestinal conditions are coincident and are best discussed together.

Hyperchlorhydria.—While it is easy to define this as an excess of hydrochloric acid secretion, there is considerable divergence of opinion in the exact definition. Some authors have adopted an extremely low standard of normal gastric acidity, so that what they would consider hyperchlorhydria is compatible with a considerable formation of fermentation acids. The writer's definition, based on the physiologic investigation of many writers and on observations as to the acidity of chyme extracted experimentally from healthy individuals, is a state of secretory excitation in which either the normal proportion of 20 parts of HCl to 10,000 of chyme is considerably exceeded or in which the total stomach contents or their relative fluidity indicate an excessive secretion. The highest hydrochloric acidity actually observed by the writer was in a case of gastric dilation with ischochymia, the total acidity by phenolphthalein amounting to 122—this expression meaning that each c.c. of stomach contents required 1.22 c.c. of decinormal sodium hydrate solution to accomplish the end reaction. The free HCl amounted to 98, corresponding to a ratio of nearly 37:10,000. But even more significant was the bulk of stomach contents, between 800 and 900 c.c., and the fact that this enormous secretion of more than 3 grams of gaseous HCl, was present six hours after an unirritating meal of malted milk. Another case, apparently purely functional, yielded 50 c.c. of chyme having a total acidity of 141 and free HCl acidity of 96, two hours after a meal of steak, bread and butter. Another patient yielded 500 c.c. one hour after a bread and butter and water meal of not more than 300 c.c. original bulk and which should have been reduced to 125 c.c., at most. Thus, although the total acidity was only 90, which is high, but within normal limits, and the free HCl 56—corresponding to a trifle over the normal standard of 20:10,000—a diagnosis of hyperchlorhydria was justified. But the excessive secretion of HCl, which is a moderately efficient antiseptic, is incompatible with any considerable degree of fermentation, unless large quantities of active fermentative microorganisms have been recently introduced or unless the hyperchlorhydria is of mild degree and there is considerable ischochymia. The diagnosis of hyperchlorhydria should, however, never be made without a demonstration that the acidity is secretory and not fermentative nor should the irritation of organic acids and by-products of fermentation in the presence of a fair but not excessive amount of HCl be construed as hyperchlorhydria.

The pain and danger of ulceration in hyperchlorhydria may be mitigated to a considerable degree, merely by administering water. The dietetic indications are: first, to avoid vinegar, and all other substances that either increase the total acidity directly or by stimulating secretion; second, to starve the body so far as chlorids are concerned; third, to administer sufficient amounts of bland proteids, as free from chlorids as possible, to take up the HCl. Ordinarily, this amounts to cutting off salt and other condiments, including those used in the kitchen, and placing the patient on a diet of breadstuffs, cereals, milk and eggs. Sugar and fats diminish the secretion of HCl and are indicated in reasonable amounts. Water—not necessarily distilled—should be administered to the amount of 2 or 3 liters daily to aid in the elimination of salines.

Euchlorhydria With Fermentation.—While, under ordinary circumstances, free HCl acidity to the amount of 15 to 20 parts in 10,000, is sufficient to prevent marked fermentation in the stomach, temporary stagnation of food in the stomach or the ingestion of bacteria with food and drink, may allow the formation of considerable quantities of organic acids, CO_2, etc. In other cases colon bacilli may be aspirated from the bowel into the stomach, or these or other *putrefactive* bacteria may be ingested. It is important to differentiate between *fermentation* and *putrefaction* and the corresponding carbohydrate or proteid foods should be temporarily avoided. Aside from obvious medicinal antisepsis and lavage, uncooked foods should be avoided and those that have been rendered relatively aseptic or even antiseptic by drying, salting, smoking, etc., may be used. These foods, it is true, are somewhat slowly digested, but slow digestion is better than rapid change attended by bacterial activity.

Hypochlorhydria.—Salt, sapid foods, HCl given at the height of digestion, small, hot meals, are the principal dietetic indications. As already explained, pepsin or, at least, pepsinogen, is almost never lacking. Many physicians regard these cases as "amylaceous dyspepsia" and either withdraw starches and sugars or administer diastase. It should be remembered that starch digestion in the stomach is always comparatively unimportant, but that ptyalin almost never fails and that its action in the stomach is interfered with only by excessive acidity. The only gastric function that deals with carbohydrates is a very moderate secretion of invertin, which splits small amounts of cane, milk and malt sugar, the latter due to ptyalin digestion of cooked starches, unless occasionally introduced as such. Obviously the failure of HCl leads to the fermentation of carbohydrates, on account of the excessive activity of bacteria and yeasts. The prime indication, however, is neither to omit the carbohydrates nor to remove them by artificial digestion, but to maintain relative asepsis. Still, bananas and other forms of raw starch may wisely be withheld and not too much carbohydrate nor fat should be allowed, as the best way to stimulate any digestive secretion is to give largely the kind of food for which it is destined—in this instance meats and other forms of proteid.

INTERNAL ASEPSIS AND ANTISEPSIS.

This subject has occasioned much divergence of opinion, due largely to differences of point of view. Most bacteriologists have held that neither HCl, the natural antiseptic of the alimentary canal, nor others artificially introduced, can be maintained at a strength sufficient to exert a positive antiseptic action. Clinical experience, however, is mainly in the opposite direction. It must be remembered that even a very weak solution regularly in contact with ingesta for considerable periods inhibits the growth, or, at least, the virulent function of microorganisms, even if not adequate to destroy them absolutely or to interfere with cultures *in vitro.* Still, in the treatment of the diseases of the alimentary canal, asepsis and the removal of fermenting and putrefying food must be relied upon quite as much as antisepsis. It would be beyond the scope of this treatise to discuss lavage, catharsis and antisepsis by drugs. At times it is important to keep the stomach empty, by resorting to rectal feeding; or the lower bowel by using foods digested almost completely and with little indigestible residue, high in the alimentary canal. Infrequent meals may serve the purpose of maintaining a fairly empty alimentary canal.

In a necessarily crude way, by the examination of the urine for indican, of the feces and stomach contents, including the detection of odors and the chemic identification of volatile products, a differentiation of the kind of fermentation or putrefaction present should be made and the corresponding food should be temporarily withheld. In this way the excessive virulence of any group of bacteria may be prevented. For instance, if there is indicanuria and if the gases of the stomach or intestine blacken lead acetate paper—indicating the presence of sulphids—the obvious indication is to reduce the proteids and especially meats. If, as often occurs in typhoid, there is a characteristic coating of the tongue, tympanites and odor of sour milk, the diet should be varied. If, in the absence of indicanuria and of notable amounts of sulphur-containing gases, there is considerable formation of inflammable intestinal gas —mainly CH_4, methane—and frequent but rather small, watery stools, we must conclude that there is an undue fermentation of cellulose and must withhold vegetable food, except meals and purees fairly free from detritus.

Sensory Disturbances of the Stomach and Intestine.—Sensation of the internal organs is normally at minimum, merely a sense of well-being attending the proper performance of function. In health the diet should be of sufficient variety and individual viands should be given intermittently, so as to insure an appetite. The sensation of comfortable satiety seems to be due to the stretching of the rugæ of the stomach, as it is almost never reached in dilation, though the patient may be conscious of having overeaten. Even in health care should be taken that the solid and liquid ingesta do not overfill the stomach. The total to be taken at a meal should not much exceed 500 c.c. in bulk, though liquids will gradually pass through the pylorus, so that at a protracted dinner, more may be taken.

The less faith we place in purely sensory disturbances, the more successful will be our treatment. Pain on deglutition may be rheumatic, but pain of the stomach or bowel, not due to local disturbance, is usually neuralgic—whatever may be the ultimate conception of this term—and occasionally tabetic. Even such pains, however, are exacerbated or excited by extremes of temperature, chemic, and possibly mechanic, irritation of food. Gastralgia usually may be resolved into the expression of an organic lesion such as ulcer, a chemic abnormality, especially hyperchlorhydria or excess of organic acids, a muscular cramp or overdistension with gas, especially if the semiliquid stomach contents form a trap preventing exit at the pylorus, while there is a temporary spasm at the cardia. There can be laid down no rule to prevent by dietetic regimen the recurrence of alimentary pain, but the exact cause in each case and the experience of the patient must be studied.

Nausea is abnormal, but often conservative, by leading to the ejection of improper or excessive food or drink. To a large degree, it is psychic and must be overcome by administering food for which the patient craves, even if not theoretically desirable, or, at least, that which is not distinctly distasteful.

Hyperkinesis.—Excessive muscular action of the stomach and probably also of the intestine is usually attended by similar exaltation of secretory activity, though digestion may actually be incomplete from lack of time. The food should be fairly bulky but without indigestible residue, rather free from liquid, and condiments should be interdicted.

Hyperkinesis, complicated with organic obstruction, or cramp of sphincters, on the other hand, requires concentrated but bland food, with water administered rather freely at frequent intervals, beginning a couple of hours after mealtime.

Hypokinesis—Sluggish Peristalsis.—A decided difference of indication exists, according as the stomach or bowel is affected. Although, to a certain extent, condiments, nuts, etc., may be indicated to stimulate gastric peristalsis, all small, seedlike, scaly and gritty or fibrous particles are likely to do more harm by lodging in the greater curvature than they will accomplish good by increasing peristaltic power. I have removed from the stomach six or eight hours or more after ingestion a certain sandy breakfast food, hulls of peas, strings and pods from string beans, asparagus, spinach, fruit skins, etc.

The small intestine clears itself more readily than the stomach, solid masses usually passing through more rapidly than pultaceous chyle, the former being, so to speak, carried on the shoulders of the valvulæ conniventes. On the other hand, the pouches of the colon and, to a still greater degree, the caecum and ascending colon, share with the stomach the mechanic obstacle to the onward passage of solid particles, although this may be counterbalanced by the stimulation of peristalsis, so that such substances sometimes cause constipation, sometimes diarrhea.

In all forms of hypokinesis, especially intestinal, care should be taken to avoid fermentable food, as far as possible. Except in the case of the stomach, residue in large, soft masses, as the cellulose of fruits and many fresh vegetables, is desirable, the objection being mainly confined to small seeds and scales or slender, tough fibers of considerable length. Such cases usually require considerable sugar to furnish readily oxidizable fuel-food and fats, both having some degree of laxative value. The free use of water, but not in too great quantities at a time, is almost always indicated.

SPICES AND CONDIMENTS.

L. R. von Korcynski (Wiener Klin. Woch., Apr. 24, 1902) has investigated the action of spices and finds that in the normal stomach they act first as stimulants and, later, as depressants. Their physiologic effect is to irritate and produce congestion of the gastric mucosa with increased secretion of watery gastric juice. Instead of increasing secretory power in states of depression, as is commonly held, they diminish still further the secretion both of pepsin and hydrochloric acid. In states of excessive secretion, however, the long accepted contraindication is upheld, on account of the danger of producing still further irritation of the mucous membrane. We must also consider the possibility of damage to the liver and, still more remotely, the kidneys, after the absorption of the volatile principles.

CHAPTER XIX.

DIET IN ORGANIC DISEASES OF THE STOMACH.

Gastric Dilatation and gastroptosis.—We must distinguish between atonic dilatation and that due to obstruction at the pylorus. The former is almost inevitably accompanied by hypokinesis and usually by a corresponding depression of secretory function. The latter is, at first, accompanied by compensatory hyperkinesis and, in many, perhaps in most cases, by secretory excess. Later, as in the heart, compensation fails and not only the obstacle at the outlet but the general weakness of the gastric wall, tends to stagnation. So far as dietetics is concerned, it is not usually necessary to distinguish between gastroptosis or sagging of the stomach as a whole, and atonic dilation, in which the greater curvature and pyloric regions sink, while the lesser curvature remains in place. The discussion of these conditions has been, to some degree, anticipated under the head of functional disturbances of motility. The general indications are to avoid food of considerable bulk or weight —remembering that a pint of water weighs about a pound, that which will distend the stomach by gases, in solution or potentially present by reason of fermentable constituents or in the form of carbonates which may be liberated as CO_2 by contact with acids.

It is a safe rule in all cases of dilatation and ptosis, not to introduce more than 500 c.c. at any one time. A moot point is as to the frequency of meals. At least 500 to 600 Grams of solid, dry nutriment must be administered daily to maintain normal nutrition, amounting to two or three times as many cubic centimeters, not to mention at least 1,500 c.c. of water. Shall we allow ample resting periods by administering this in a few meals, or lighten the task of the stomach by administering a little food every little while? At opposite extremes, we have the plan of giving one large meal in twenty-four hours and an elaborate schedule of 13 to 15 meals daily. The former plan overdistends and places too much weight in an organ already enlarged and too low. The latter allows no time for physiologic rest, none for the completion of gastric digestion before the next meal time; it is even impracticable to administer food for any length of time which shall pass through the stomach in the interval allotted between subsequent meals even if the patient is allowed no time for sleep, except in short naps. Yet this ridiculous time table of meals is gravely supported by authority. In extreme cases, the patient may be put to bed, or, at least, confined to the house and veranda, avoiding all exertion so as to diminish the need of food to a minimum. Two meals a day may then be given aggregating the "bare subsistence" ration, already cited. Under ordinary circumstances, three or four meals may be given and, sometimes, five or six, according to empiric trial. The proteid should be given in the form of soft boiled egg, chopped or scraped fresh beef and lamb, purees and vegetable flours, or some of the artificial concentrated foods. Carbohydrates should be mainly dextrinized—toasted—malted or in the form of sugar. Fats should be mainly in the form of butter and cream. Chocolate (either eaten from the sweet cake preparations or prepared with milk as a beverage), custards, thick gruels, and various proprietary foods may be employed. Owing to the need of economizing bulk, very little water or other beverage should be given at meal time, but from 50 to 100 c.c. should be drunk at frequent intervals, from about three hours after till an hour before meal-time.

Gastritis.—In acute gastritis, including especially the traumatic form due to heat and chemic corrosion, there is a conservative failure of secretory function and no attempt should be made to use the stomach for digestion, although locally sedative and antiseptic drugs may be administered and, usually, whatever water is needed. For two or three days food may usually be dispensed with; afterward nutrition should be conducted by the rectum for a week.

In subacute gastritis, due to alcoholism, lower degrees of thermic and chemic irritation, including the fermentative changes in food, "taking cold," etc., the needs of the stomach are less urgent and those of the patient for nourishment more so, thus the regimen begins at a point reached only after a week or ten days in the care of acute gastritis. At first, there should be no attempt to secure gastric *digestion,* but the stomach is used simply to introduce food into the upper intestine. The gastric cycle should consist of alternations of two periods, that in which food is passing into the intestine, when any medication should be directed toward assisting this function and that of rest, during which medication should be directed toward the condition of the stomach itself. It is nearly or quite useless to introduce bismuth, etc., while the stomach is full of food. The meals should be as far apart as possible—say every eight hours—and about three hours must be allowed for the passage of food and about one hour before each meal for the discharge of the local dressing used, leaving three three-hour periods for the treatment of the stomach itself. It is in such cases as these that we have the principal indication for peptonized milk and gruels, crust coffee and proprietary, semi-digested foods.

In chronic gastritis we can do little damage to the already degenerated and often fibrous glandular membrane and the indication is to afford nutriment to the body and stimulate the flagging power of the glands. There is usually need of hydrochloric acid and strychnin—other bitters may usually be dispensed with—and the food should be hot, concentrated, rich in salines and even in condiments. Plenty of water should be given between meals and such treatment may be directed at the lesion as will not interfere with digestion, but the writer has little faith in medicinal measures in such cases except such as deal directly with the secretory, motor and sensory functions, although washing and spraying of the jejune stomach are beneficial if the case is not too far advanced. Many such cases are complicated with renal and hepatic or cardiac disease and the diet must be governed accordingly.

In acid gastritis, the dietetics must be along the functional lines already described.

Achylia gastrica.—Absolute achylia is rare, but there are many instances in which there is no free HCl, but little combined HCl, so little rennin that only a soft curd is formed with milk and so little pepsin that digestion is slight after supplying HCl. For practical purposes, marked hypochylia and achylia must be considered together, just as hypochlorhydria and absolute achlorhydria. Functional achylia—or at least marked hypochylia—is seen in acute fevers, Addison's disease, shock, and in nearly every case when death is imminent. Organic achylia or anadenia is the ultimate, degenerative stage of chronic gastritis. It must be considered that the anadenia is seldom complete and that the achylia is, after all, largely functional. There are also cases of achylia, with good motor function, occurring in supposedly healthy persons and discovered either by physiologic experiment on students or in the investigation of some intercurrent affection. It is, as yet, impossible to say whether such cases are organic or functional.

In acute achylia, due to shock and other forms of nervous depression, the indication is rather to stimulate by drugs, hypodermatically, than to administer food. Rectal alimentation is scarcely indicated as there is probably, in all such cases, a general failure of ferments and even of absorptive power. In Addison's disease and other chronic causes of general achylia, the patient is likely to die of starvation, not only in the midst of plenty but with plenty in his midst, yet an attempt at nutrition by means of predigested foods, with the digesting power still further supplemented by the administration of vegetable digestive ferments, should be made. Meantime, the customary means of stimulating function by strychnin, etc., should be employed.

In desperate cases lying between acute shock and chronic functional achylia, subcutaneous nutrition may be attempted.

In gastric anadenia, the prognosis is locally hopeless, but systematically favorable. The stomach is never of prime importance as compared with the intestine and its tributary glands. The nature of the diet must depend upon gastric motility and intestinal digestion. Sometimes, even the grossest neglect of dietetic hygiene is not attended by serious interference of nutrition, but, in the majority of cases not discovered accidentally, intestinal digestion has begun to fail and it is necessary to give semi-liquid, liquid and pultaceous food, free from hard and fibrous particles, and it may be necessary to administer chopped, raw pancreas, its extract or some vegetable ferment. It is scarcely necessary to explain that, in cases of this nature, pancreatin is not destroyed in passing through the stomach, indeed, something closely analogous to intestinal digestion may be made to take place in the stomach itself.

Gastric cancer.—Excepting purely mechanic considerations, the diet in gastric cancer must be chosen according to acidity, motility, and the presence of catarrh and ulceration. However, there is a decided impression on the part of many physicians that meat increases the virulence of the cancerous process. Be this as it may, the increase of blood supply during active function probably does hasten the development of the disease and it is a good policy to stimulate the gastric function as little as possible. As cancer has a considerable duration it is impossible to resort to rectal alimentation, except occasionally, but an unirritating and mainly vegetarian diet may be employed to reduce the function of the stomach to a minimum.

Cancer of the cardia—or even higher in the esophagus—must be considered as a menace to the ingestion of food. Every precaution should be taken to avoid hard, dry or chemically irritating food, and, as the disease progresses, the diet must be progressively liquid. Except as absolutely required, instruments should be kept out of the esophagus, as they hasten the development of the disease. With due care in these matters, many, perhaps most, such cases may be kept alive without the establishment of a fistula, death ensuing from gradual toxemia and asthenía (not asthénia) before actual inanition is threatened. If a fistula must be made, it is better to short-circuit the stomach entirely so as to avoid the stimulation of the malignant process, and to tap the upper intestine. A very important point after the establishment of the fistula is that the dietetic management of the case is no longer surgical, but belongs within the domain of internal medicine. The common error is to overlook the quantitative and qualitative needs of the body, especially in regard to salines, carbohydrates and fats. Often a nearly proteid diet is instituted, and, naturally, the resisting powers of the patient rapidly decline. It is doubtful whether the mastication and insalivation of food is of practical utility, as the action of ptyalin is never of much importance compared with the vigor of amylopsin. If a gastric fistula has been established, mastication favors gastric digestion by reflex stimulation of secretion. If the fistula is made into the intestine, all activity on the part of the stomach should be avoided, and, therefore, mastication should not be recommended. The nutriment should be carefully estimated with regard to supplying the full ration of the various organic and inorganic foods, and should be fairly aseptic, though, obviously, its appetizing nature may be disregarded provided that it is not disgusting to the patient. Equally obvious is the necessity of providing vicariously for the ordinary mechanic functions of mastication and maceration.

The dietetics of pyloric cancer depend upon general principles already discussed in connection with motor and secretory function.

Gastric ulcer.—Owing to the difficulty of differential diagnosis and the identity of several complications, this practically includes the consideration of duodenal ulcer. A positive diagnosis can be made only in the presence of demonstrable hemorrhage, but many cases exist in which this is never present and which require the same dietetic precautions. The writer believes that the term *ulcer* should be used in the same broad sense of a superficial solution of contiguity, in regard to the stomach, as in speaking of any other part of the body. Hence, we must distinguish:

1. Acute corrosive ulcers, for which the diet will be that discussed under acute gastritis;

2. Chronic catarrhal ulcers, somewhat analogous to eczematous ulcers of the skin, but which seldom present definite symptoms. The diet is the same as for chronic gastritis, but with additional precautions to avoid mechanic or chemic irritants that might excite hemorrhage. Many ulcers crudely termed catarrhal, are due to essential vascular disease, especially fibroid and calcareous degenerations and require the same dietetic precautions as are discussed in Chapter XIV.

3. Varicose ulcers, including both the stomach and esophagus, and obviously, varicosities in which there is merely the danger of rupture. These are almost always due to back pressure from a sclerosed liver or from some direct obstruction in the portal current after the formation of the portal trunk. In the dietetic management, there must be considered (a) the hepatic condition, non-hepatic obstruction being scarcely amenable to any special restriction of diet, (b) the danger of causing hemorrhage, either by mechanic irritation of an ulcer or distended vein, by exciting reflex vomiting or by the size of a bolus passing through the esophagus, (c) the indications of the concomitant catarrhal state;

4. Angiospastic or infarctive ulcers, representing two possible explanations of the typic round ulcer, to which the term *gastric ulcer* is usually restricted.

For this form of gastric ulcer, the diet must be regulated according to the acidity, which is theoretically high. But, though ulcer is imminent in hyperchlorhydria, it is not so very often that it actually develops, and, conversely, an ulcer once established is not necessarily attended by hyperchlorhydria. During, and for at least a week after, the cessation of any considerable hemorrhage, no food or drink should be given by the stomach; in fact, the stomach should simply be let alone. The attempt to arrest hemorrhage by ordinary styptics and by lumps of ice is futile, the latter melting and reaching the body temperature in a very few minutes. Even in nourishing by the bowel, care must be taken not to raise blood pressure by introducing too much liquid at once, nor, reflexly, by exciting expulsive efforts or nausea. In resuming gastric feeding, the blandest food should at first be given, beginning with peptonized milk and gradually adding bread or crackers soaked in it, then gradually changing to soft boiled eggs or custards without peptonization, and thence passing to a more liberal diet. Any mechanically harsh or chemically irritating food should be interdicted for several weeks, and, in order not to cause further digestion of the site of the ulcer, digestants should be withheld, and, if necessary, the acidity of the stomach counteracted by magnesium oxid or hydrate—not by a carbonate—while fermentation is prevented by antiseptics.

GENERAL RESUME.

In the practical consideration of gastric conditions, one should avoid all such terms as "nervous dyspepsia," and should endeavor to determine the exact conditions present in each case, without being too much influenced by the a priori probabilities. Even conditions that appear to be pure neuroses are very likely to be due to some unexplained organic cause or a neurosis may be engrafted upon a slight local lesion. Such neuroses as belching, heart burn, nausea and vomiting, must be considered as symptoms of more general faults of innervation or of definite organic disease. There may be considerable subjective complaint of a stomach that responds normally to the various chemic and motor tests.

In such instances, there may be a latent ulcer or catarrh, or the trouble may be due entirely to reflex disturbance or to some general state such as neuralgia. Rarely or never is it possible to sum up the state of the stomach in one disease-term. Cancer ultimately includes one form of ulcer, usually catarrh, and either obstructive or atonic dilation. Indeed, catarrh practically always complicates every other organic disease and arises in mild degree whenever a neurosis persists for any length of time. The functional conditions of acidity, motility, etc., are usually associated, all forms of innervation being usually depressed or exalted together but often, paradoxic associations occur while the functional states necessarily follow, symptomatically, upon the organic diseases. Thus, the diet must be chosen in accordance with several sets of general principles and must then be modified to conform somewhat to the patient's tastes. So far as possible, the viands used should be such as are ordinarily employed by persons in health, but prepared with especial care and properly selected. Except in critical conditions, gruels, flour pastes and exclusive milk dietaries should be avoided, and, in all chronic conditions, it must be borne in mind that the patient cannot recover general or even local digestive strength on a diet that is distasteful or that is merely nutritive and unappetizing. The stomach must be brought up to the level of digesting ordinary, though simple and selected foods. It is a mistake, except in acute conditions, to reduce the dietary to the level of the digestion, for, usually, the more the diet is reduced, the lower will fall the digestive power of the stomach.

CHAPTER XX.

DIET IN DISEASES OF THE INTESTINES.

In all acute, serious conditions of the intestine, whether inflammatory—catarrhal, peritonitic or septic—or mechanic, as obstruction, nutrition should be suspended for two or three days, unless the previous state of the patient has already reduced him to a point dangerously near starvation. When it is imperative to resume or to enforce nutrition by the mouth, the general principle to be followed is to give foods which will be thoroughly digested before the point of disease is reached. In diseases of the small intestine, and especially those high in the bowel, the literal fulfillment of this requirement is usually impossible, but the food should be bland and unirritating. At first, peptonized milk and gruels, including toast water, may be employed, gradually returning through toasted bread stuffs, soft boiled or raw eggs, custards and broiled fresh meats in small portions, to an ordinary light diet. In some conditions of involvement of the small intestine, or even of the cecum and right colon, rectal nutrition may be carried on; in others there is such active peristalsis as to render this means futile and, often, a rather protracted starvation is the wisest course. The lower the process is situated the less important locally is the nutriment itself and the more important the indigestible residue. The routine sifting of the feces under ordinary light vegetable diet will reveal a surprising amount of light, chaffy, stringy and scaly residue. While this is much less irritating in the moist state than it appears to be when dried, it is obviously to be avoided, so far as possible, even in disease of the anus. As a rule the mineral ingredients of foods may be disregarded, but, whenever there is found a tendency to intestinal sand—which may be due to several chemic compounds and to vaguely understood conditions—it is well to avoid ordinary foods and to nourish, so far as possible, on fats, chemically pure carbohydrates, such as starch and sugar, and prepared proteids, thus eliminating most of the magnesium and calcium salts. By sifting the feces of careless eaters, fragments of bone, bits of wood and paper, etc., may be obtained, of whose ingestion the patient may be entirely unaware, while the finding of large seeds and fruit pits is a common occurrence.

Aside from the residue, food may be chemically irritating, especially on account of fermentative and putrefactive changes. In such cases the aim should be to determine the kind of micro-organic life in the intestine and to administer such food as shall favor the development of the opposite kind, in order to change the pabulum and lessen the virulence of this or that bacterium. It is rather impracticable to solve the problem by culture methods, as these do not enable quantitative deductions to be drawn except as to germ content in general. A very fair idea of the condition may be obtained from the odor and inflammability of the intestinal gas. Markedly inflammable gas with no ammoniacal or sulphurous odor, and with either no particular odor or that of vegetable acids, lactic, butyric, etc., indicates fermentation of vegetable food, the inflammability being due to methane which is derived from cellulose. On the other hand, proteid decomposition produces various non-inflammable, foul smelling gases as well as hydrogen sulphid, derived from eggs, beans and various other sulphur-proteids, while the combination of hydrogen sulphid with carbon dioxid produces water and carbon disulphid. It may be of interest to note that the writer has never found the intestinal gas inflammable at necropsies, probably on account of gradual oxidation.

While the chemic qualities of the intestinal contents depend largely on bacterial action, special mention should be made of contaminating microorganisms, bacterial and fungoid, as a cause of irritation of the intestine itself. Cholera morbus, including cholera infantum, is a non-specific sepsis, corresponding quite closely to sepsis developing from the colonization of various germs in wounds. Certain recent experiments, however, show that at least some epidemics of cholera nostras are due to the bacillus of dysentery. It is impossible to draw a line between inflammatory and toxic conditions in cholera morbus and, obviously, the use of infected food may exacerbate any other inflammatory condition already present.

In proctitis and other conditions located low in the bowel little attention need be given to the diet except to avoid mechanic irritation, either from residue or from scybalous masses.

Colitis, including more or less localized sigmoiditis, typhlitis and scolecitis (commonly misnamed appendicitis) is largely due to increased virulence of the colon bacillus, through increased time of breeding without discharge—constipation—unusually favorable pabulum—too largely proteid and especially meaty diet—and various other circumstances. The possibility of producing either typhlitis or, especially, scolecitis, by the ingestion of solid residue and small foreign bodies, is doubtful, but it is rational to avoid further irritation, both by reducing the proteid and especially meaty and sulphur-containing foods and by excluding all cores, skins, pits, seeds and other harsh vegetable residue.

An acute attack either of scolecitis, typhlitis, general colitis—dysenteric or otherwise—or inflammation of the upper bowel, as in the various forms of non-specific enteritis, typhoid, etc., requires a choice of food that will be digested mainly in the stomach and upper portion of the small intestine. Except in typhoid, on account of its duration and progressive nature, it is well to give no food at all for a couple of days. This is especially true of scolecitis, in which the septic element is almost the sole danger and is true to a less degree of cholera morbus.

When nourishment is recommended, it should consist mainly of toasted bread and soda crackers, cereals and milk. Prepared foods such as malted milks, albumose-milk, and the various combinations of milk and cereal may be employed. Tea, coffee and chocolate should be allowed only sufficiently to flavor the hot milk with which they should be prepared. Meat and meat extracts and teas should be debarred for several days, both because their extractives add to the surplus of effete matter already in the system and because, in their absence, the colon bacillus experiences a lack of pabulum that diminishes its virulence.

The dietetic treatment of chronic typhlitis consists in making the patient nearly a vegetarian. Beef, lamb, sweetbreads, chicken, comprise most of the available meats. Roasting and broiling are almost the only allowable modes of cooking. Preserved meats, fish, shellfish, and pork, are to be regarded with suspicion. Coarse vegetables, as cabbage, onions, carrots, sauerkraut, beans, corn, on account of its harsh seed-coats, greasy preparations of all kinds, excepting clean, sweet butter, cream and olive oil, are to be avoided. An excess of sugar may prove to be an irritant, although not directly concerned in the virulence of the colon bacillus. With a variety of breadstuffs, crackers, but not biscuits (in the American sense), nor pancakes nor other hot breakfast foods, with potatoes, sweet potatoes, pumpkin, squash, peas, green beans, tender lettuce, celery, asparagus tops and the many excellent cereal novelties now on the market, the patient need not suffer for lack of variety. For dessert, fruit free from seeds, skin and core, custards, bread and cereal puddings, gelatin puddings and cream dishes, may be allowed. Alcoholic beverages, tea, coffee and strong chocolate must be avoided.

An important item in the treatment of typhlitis is to insure the proper condition of the intestinal contents. Therefore, the meals should be eaten at regular intervals, at least five hours apart, mastication should be thorough, the dentist's aid should be invoked if necessary and attention should be paid to any defect of gastric digestion.

The same principles apply to other conditions of intestinal inflammation, acute and chronic. While as a rule the non-specific inflammations (meaning inflammations not due to a definite pathogenic microorganism and having no reference to syphilis in particular) are due to an excess of proteid in the diet, so far as the chemic nature of the food acts as an etiologic factor, yet an excess of carbohydrate and especially of sugar may excite a mild degree of inflammation. Fat is seldom taken in sufficient quantity to cause trouble but, in case of obstructive jaundice, the excess of undigested fat predisposes to bacterial decomposition and may excite inflammation from the irritation of fatty acids. In general, it should be remembered that fatty and oily substances, while soothing externally, are, by reason of their digestion into glycerin and soaps or of their decomposition into organic acids, rather irritant internally. Thus, the oil treatment of scolecitis, etc., is not warranted. A mineral oil, of absolute purity—purpetrol—may, however, be employed internally as an emollient.

The influence of diet in conveying the various parasitic diseases, both of animal and vegetable origin, requires no detailed discussion.

DIET IN TYPHOID.

The diet in typhoid fever may be considered here. While it has long been taught that no solid food should be given in typhoid, there is, at present, not only theoretic but considerable practical evidence that more attention should be paid to the physical state of the food in the bowel than in the cup. It is absurd to class a milk curd as a harmless liquid and a cereal pulp as a solid that may rupture the bowel, simply on account of the appearance of the food before it is ingested. The continued use of milk is objectionable on account of its constipating qualities, the tendency to establishing a certain form of bacterial decomposition, indicated by the characteristic odor and coating on the tongue—both macroscopically and bacteriologically—the deficiency of iron, carbohydrates and, to a less degree, of proteid as compared with fats, and its insipidity. Broths and meat teas, unless the shreddy sediment is included, represent little else than gelatin, extractives, and minute amounts of carbohydrate and fat. Meat juice represents about 6 per cent of proteid, with some gelatin, etc., but the danger of contamination with tubercle bacilli, ova of teniæ and other less common pathogenic parasites must be remembered.

A more rational dietary allows toast, crackers, the softer cereals, soft boiled eggs, broiled and scraped meat, custards and chocolate, the last two items including some sugar. Milk must remain a staple article in the diet of typhoid and all other diseased states of similar nature but it should be mingled with other foods. Thus, while two quarts daily of milk is adequate only for fats and, approximately for proteids, there being only about 80 grams of each organic nutriment in two quarts, the use of rice, farina, toast, crackers, etc., enables the deficit of carbohydrate to be made good. In all depressed conditions without especial organic interference with gastric and upper intestinal digestion, the nutriment should be given in nearly equal parts, at intervals of about four hours. Milk, reinforced with the substances mentioned. is adequate in a total bulk of from 1,500 to 2,000 c.c. corresponding to six feedings of 250 to 350 c.c. at a time, or from half to two-thirds of an ordinary cupful. With the list suggested, a considerable variety is available to tempt the patient's appetite. There is, of course, no objection to resorting to peptonizing powders, pawpaw extracts, etc., to aid digestion, nor to antiseptics to diminish fermentation. With this regimen, a limited experience apparently shows that the duration of the fever is rather short and the patient's appetite is not so ravenous and difficult of control during convalescence. After a week's freedom from fever, greater abundance and variety of breadstuffs, cereals and meats, may be allowed and, two weeks after defervescence, a liberal, light diet may be given, but full diet should not be allowed till the patient is able to take some exercise.

DIET IN DIARRHEA.

This should be determined according to the real cause, but, in general, it may be said that an acute diarrhea requires the suspension of nutriment. Chronic diarrhea calls for food free from irritating waste, not prone to fermentation or decomposition, fairly concentrated, and digestible in the stomach and upper bowel.

DIET IN CONSTIPATION.

The time-honored idea in treating constipation dietetically, is to administer food rich in cellulose and other solid residue. Such food is laxative, partly by direct mechanic irritation, partly by chemic results of fermentation, partly by the pressure of such gases as methane and carbon dioxid, partly by the irritation of the sugar contained. Figs, prunes, dates, apples, bran flours, molasses, etc., are the common ingredients of such a diet. While allowable in mild cases, without tendency to colonic irritation, including a vulnerable appendix, the exact cause of the constipation should be sought. More often than strict motor sluggishness, lack of fluid is a cause of imperfect action of the bowels. Among women and men of sedentary habits, who do not feel the need of water as a cooling beverage, it is frequently the case that this drink is almost never indulged in. To attempt to force peristalsis by irritants in such a case is as irrational as to crowd on steam in an engine impeded by lack of lubricant. Water should be taken as such, in the amount of from one to two quarts daily, or from four to eight glassfuls. Allowing a half glassful to each meal, the remainder should be distributed between meals and in the evening. When water is not taken as a beverage, tea and coffee, which are constipating on account of tannin, are usually employed as substitutes. In such cases there is the double indication to discontinue the tannin and to increase the amount of water.

With regard to mineral waters, it should be remembered that they act on account of the water and the dissolved chemicals, not from any mysterious power due to their being natural. At certain popular spas it is difficult to understand how the waters can be free from organic contamination. As a general rule, water should not be chemically pure, on account of the exosmosis produced, which is said to lead to serious results, and even to the death of certain lower animals. Mineral waters, like proprietary compounds, should be prescribed only when the dosage of the various ingredients happens to fit the special indication. The greater the number of ingredients in appreciable quantity the more difficult the application of the water. Calcereous waters are to be avoided if there is a tendency to certain calculi, and in the aged, and other ingredients are to be avoided according to various conditions present. By far the simplest way is to use ordinary potable water of no notable mineral content, and to add whatever saline is needed.

In the treatment of either diarrhea or constipation it is bad practice simply to try to produce the opposite condition. For instance, in achlorhydria with constipation, laxative mineral waters, especially those rich in magnesium and containing little sodium chlorid, tend to decrease still more, the formation of hydrochloric acid.

Beside normal peristaltic action and the presence of an abundance of watery secretion, the writer has already called attention to the importance of carbon dioxid as a factor in stimulating the movement of the bowels. After an ordinary meal at least 500 c.c. of chyme enters the duodenum, and the acidity is at least equivalent to one gram of absolute hydrochloric acid. This is more than neutralized by alkaline carbonates in the bile and pancreatic juice and it is matter of simple arithmetic to show that 44/73 grams of carbon dioxid is produced by each gram of hydrochloric acid. At the body temperature this corresponds to about 1,200 c.c. of gas, whose pressure upon the bowel is an important factor in stimulating peristalsis. Thus the maintenance of proper gastric acidity is important in relation to the intestinal peristalsis. While the ingestion of moderate amounts of aerated water stimulates motility, undue amounts of gas, either introduced as such or produced in hyperchlorhydria, may cause dilation of the stomach or upper bowel,

CHAPTER XXI.

DIET IN HEPATIC DISEASES.

The majority of hepatic diseases are surgical or of general pathologic nature, so that the reason for their location in the liver is not apparent, while they are uninfluenced by diet except in the most general way. The dependence of hepatic abscess upon dysentery and chronic colitis with increased virulence of colon bacilli renders it necessary to pay some attention to diet with regard to the possible introduction of amœbae and specific bacilli of dysentery and to the production of catarrhal states of the lower bowel.

While the majority of hepatic *diseases* are not germane to this discussion, by far the greatest number of *cases* of hepatic involvement are included under the term sclerosis or cirrhosis and are largely due to diet, as well as amenable to dietetic regulation.

HEPATIC SCLEROSIS.

It is quite universally admitted that hepatic sclerosis is practically incurable, yet diet accomplishes at least as much in the relief of the disease and the prolongation of life as any other therapeutic factor. Not to attempt a scientific classification of the various forms of hepatic sclerosis, it is generally true that most of the so-called hypertrophic cases are due to biliary inflammation which is usually of the nature of a septic catarrh, while the ordinary atrophic sclerosis, which is at least ten times as frequent, is almost invariably due to a poison which reaches the liver through the portal vein. Rarer forms of the disease are due to general toxemia, as in lead poisoning, malaria, etc., while the sclerotic processes which follow or attend a granulomatous or neoplasmic affection, should be separated from general sclerosis. Most authorities ascribe to alcohol a prominent or principal part in causing hepatic sclerosis. The writer's experience is in direct opposition to this view—possibly due to a difference of clientele—as he has found more cases in total abstainers than in heavy drinkers. In regard to the etiology in moderate drinkers, it is a matter of individual judgment whether we shall assign a hepatic sclerosis to the indulgence in, say, the 4 per cent. of alcohol in an average of 250 c.c. of beer daily, or to higher percentages in correspondingly smaller drafts of wine or whisky or to the average ingestion of a drink or two a week, or whether we shall look elsewhere for the cause. Unquestionably, excessive indulgence in malt liquors tends to fatty infiltration of the liver, which is often attended by more or less interstitial change while the excessive use of strong liquors tends directly to irritation by the portal blood with production of an increased amount of interstitial tissue. Whether the interstitial change is primary or whether it simply fills up deficiencies due to the atrophy of epithelial cells, is important pathologically, but not from our present standpoint, so that it would be useless to argue upon this point of disagreement.

CAUSE OF HEPATIC SCLEROSIS.

In most of the writer's cases of hepatic sclerosis with or without an alcoholic history, there has been a definite history of gastric disturbance of chronic nature and, in many instances the patient has been intemperate in the use of food. One patient, "an officer and a gentleman," was described by his attending physician as a teetotaler as regards alcohol but a perfect hog so far as solid food was concerned. There is no reason why lactic, butyric and other acids of carbohydrate fermentation, the products of rancidity of fats and of nitrogenous decomposition, whether introduced in high meats or formed in the alimentary canal, should not produce hepatic sclerosis as well as alcohol and, indeed, alcohol itself, is formed to some degree in the alimentary canal by microorganisms. Some experiments incriminate indican alone as a possible cause. Drugs may also be responsible for the effect on the liver for we must remember that most drugs exert a prominent secondary action on this organ and that mineral poisons are found, post mortem, in relative excess in the liver, while alkaloids, either of medicinal plants or of bacteria, are, to some degree, retained by and destroyed in the liver. While many patients with hepatic sclerosis give a history of self-medication with patent medicines, we must also consider the possibility of damage from salicylic acid, boric acid, etc., used as preservatives of foods, and from the continued administration of iron, arsenic, mercury, phosphorus, etc., by physicians.

Most of the dyspepsias apparently connected etiologically with hepatic sclerosis, are of the hypochlorhydric type; hyperchlorhydria is much less common and rarely so persistent, and as the free acid itself cannot reach the liver it is doubtful if the latter form of dyspepsia is a genuine cause.

DIET IN HEPATIC SCLEROSIS.

Once established, hepatic sclerosis calls for a regulation of gastric digestion and an avoidance of fermentable and fermenting foods as well as of "tonic" drugs which are apparently indicated. While meats are not to be interdicted, their use should be reduced to a very moderate portion, once a day. Water should be given freely, between meals, in order to facilitate the removal of toxic matters. Lavage of the liver may be accomplished either by gastric lavage, leaving the stomach full of hot water, or by having the patient drink a liter or a liter and a half of hot water, flavored with salt or some fruit juice, if preferred, during the course of an evening. The use of saline waters, pure vegetable acids, etc., is often recommended to stimulate the hepatic function but the writer is unable to express an opinion for or against such treatment.

PANCREATIC DISEASES—INTESTINAL INDIGESTION.

Diabetes has already been considered along with diseases of the ductless glands. Organic pancreatic diseases are seldom diagnosed and the diet must be in accordance with general principles. It should be adequate, simple, easily digested and, so far as possible, digested in the stomach. It should be regulated in accordance with the actual state of intestinal digestion.

Intestinal indigestion is a term commonly used but vaguely understood. Aside from the milk-curdling ferment, which is already provided both by the stomach and the pancreas, the only ferment known to be furnished by the intrinsic intestinal glands is invertin, which splits into single hexoses the double hexose, maltose, formed from starches by ptyalin of the salivary glands—if any maltose thus formed reaches the intestine—and by the much more energetic amylopsin of the pancreas. Invertin also splits lactose which is an important element of the diet of infants and, to a varying degree, of civilized adults, and saccharose which is used by the average American to the extent of about 100 grams daily. With this exception, what is termed intestinal indigestion, is really pancreatic indigestion. The scientific determination of intestinal indigestion must depend upon extraction of the contents of the duodenum, which is mechanically difficult and physiologically unsatisfactory because of the prevailing ignorance as to when we should expect to find either digesting chyle or an active pancreatic secretion; or upon the examination of the feces which is not pleasant but which is easy enough. Unfortunately, the feces represent pancreatic digestion only after an average delay of twenty-four hours and influenced by two unknown quantities—intestinal absorption, and intestinal fermentation and putrefaction—and by one fairly well known quantity—invertin action. It must also be remembered that while the stomach retains its contents for a fairly definite time, during which quite a definite progressive change takes place, intestinal digestion and the movement of the chyle are simultaneous processes which do not necessarily occur *pari passu* and of which—unless in the presence of a fistula—we have no knowledge between the very beginning and the end.

The standards of fecal examination at present are very easily stated, but they are inadequate and the exact significance of deviations from the standard is not well understood. In the filtrate, or, if the feces are dense, in the watery extract, there should be no proteid nor carbohydrate recognizable by the ordinary clinical tests. There is a considerable precipitate with phospho-molybdic acid but, in the absence of albumin and of peptonization by the copper test, this precipitate is undoubtedly due to ammonia and amido-acids as well as, perhaps, to alkaloids and various other substances. Fats can always be extracted, to a varying degree, according to the diet. There are also present nutritive materials in tough inclosures of fibrous tissue or cellulose but, with these exceptions, there should be no macroscopically visible masses of nutriment. If curds are present, as in infants or patients on a limited diet, the milk should be mixed with lime water and either the digestive powers of the body should be increased, or predigestion or the simultaneous administration of digestants should be practiced. As fats are not an essential food, they may be excluded in cases of biliary obstruction or intrinsic failure of pancreatic digestion but proteids and carbohydrates are indispensable. There is no non-toxic end product of proteid digestion and the commercial "peptones" do not respond to the ordinary clinical tests for peptonization, although milk, eggs and cereal albumin may be predigested to the stage of albumose. Either maltose or glucose may be given as the representative of partial or complete carbohydrate digestion, but the sweet taste is apt to cloy and the sugar may be irritating, so that it is usually better to digest starches within the body.

CHAPTER XXII.

SPECIAL METHODS OF INTRODUCING NUTRIMENT.

Baths.—The immersion of a patient in a bath of warm milk or other nutritious liquid is an old method of treatment, now little used, on account of skepticism as to its efficacy. Ordinarily, however, no harm can follow such bathing, and it is barely possible that, with a soft skin, further stimulated by rubbing, some nutriment may thus be introduced, though probably no more than by inunction. The chemic changes induced by a galvanic current in milk, etc., prevent the addition of this aid to absorption, which is available in the case of certain drugs.

Inunction.—This method is limited to the introduction of oily substances by friction, the inner surfaces of the thigh and upper arm, the axillary regions and abdomen being sites of election, on account of the thinness of the epidermis and, possibly, a better development of lymphatic channels. Twenty-five grams of oil or fat may be introduced at one thorough treatment and the inunction may be repeated daily or, occasionally, oftener. Especially in the case of marasmic infants, flannel cloths soaked in cod-liver oil may be applied next to the skin with the idea of obtaining gradual and spontaneous absorption. For adults, in whose case emergent methods of nutrition are indicated, it is usually necessary to avoid any oil that may become rancid or any method that may interfere with appetite. Oleum theobromae is excellent, on account of its pleasant odor and the fact that it is not prone to decomposition. It may be obtained in bars, like sweet chocolate, so that the estimation of the amount used is easy. Cocoanut oil or butter, often confused with the former, is softer and of fainter though similar odor, and is, perhaps, preferable, especially for patients who dislike the rather marked chocolate odor of the former. Various other oils and fats may be employed, but, just as with the administration internally, it must be remembered that mineral oils and fats have no nutritive properties whatever. Unfortunately, the introduction of a fat into the skin does not insure its utilization by the system. Still, the same remark applies to nutriment given in any other way. The physician's responsibility ceases when he has furnished the necessary nutriment and done the best possible to secure its assimilation. Conversely, he has neglected his duty if he has not supplied as nearly as possible the full ration, by one route or another, and neglect is not excused in this or any other branch of therapeutics on the ground that a harmless expedient may not prove successful.

Rectal Enemata.—While, normally, there is neither much absorption in the rectum nor reverse paristalsis, so as to force its faecal contents into the upper large intestine, where there is certainly considerable absorption of water and soluble matter, it has been abundantly demonstrated, both scientifically and clinically, that nutrient material introduced into the rectum is both absorbed and, if necessary, actually digested, at least to a considerable degree. At the same time, it is expedient to accelerate this double process by predigesting the food, so far as practicable, especially as predigestion or the selection of partially digested nutriment is so simple.

By clinical experience the limitations of rectal alimentation are quite well defined, namely, that full nutrition is almost never attained; that the bowel seldom remains tolerant for more than one or two weeks and almost never more than six weeks; that the food must be liquid or finely emulsified; that it should be introduced at about the body temperature to avoid stimulation of peristalsis; that it must be retained for at least half an hour to secure any appreciable degree of absorption, and that satisfactory results require the regular retention of enemata for two or three hours.

Since the principal indication for rectal alimentation is gastric irritability, and since the tolerance of the bowel itself is limited, the writer holds that the simultaneous use of both stomach and bowel is almost never justified, but that each should be used alternately to secure physiologic rest of the other.

To avoid contamination with faeces and to anticipate an evacuation of the bowels that might interrupt the period of absorption, a cool or lukewarm injection of physiologic salt solution should be given about an hour before the proposed nutrient injection. A longer time allows the accumulation of new faecal matter, while a shorter period is scarcely sufficient for the bowel to regain its quietude.

The nutrient enemata, allowing for the periods of cleansing, absorption and rest, can scarcely be given at shorter intervals than four hours, though, if one is lost, it may be repeated after a cleansing injection and an hour's delay. As a rule, four or five small enemata or two or three large ones should be the limit for a day. In the long run, more food may be introduced and the tolerance of the bowel may be longer retained on such a schedule than by attempting to force nutrition, though the latter plan may be successful for a day or two. While the size and number of injections must depend upon experience in individual cases, the writer's preference is to give as large and therefore as few injections as possible. The old rule limited the size of the injection to 4 to 6 ounces, or about 125 to 175 c.c. Four to six such injections would be necessary to maintain a satisfactory minimal ration. By using a soft, thick tube and by introducing the nutriment very gently, at a height of 10 to 14 inches, with the hips elevated and the body inclined to the left, as much as 500 c.c. may often be successfully introduced, especially after the first day or two. Thus, as a rule, three injections of 250 c.c. each—about half a pint—may be given for a day or two and then gradually the amounts may be increased and the intervals lengthened, till the patient is receiving 1,000 c.c. daily, in two portions.

It has been the custom to accompany or to precede the injection by some form of opium, usually in starch paste or in suppository. This is objectionable both on account of the systemic effect and the local sedation of function. If a sedative of peristalsis is absolutely necessary, cocain, eucain, orthoform, etc., may be used, but by injecting with the utmost gentleness, holding the buttocks together after the injection has entered, and by summoning the inhibitory powers of the patient, it is usually possible to dispense with drugs.

In most instances it is both possible and desirable to introduce water and some drugs, such as strychnin and internal antiseptics and astringents, laxatives, etc., by the mouth. Other drugs should usually be given hypodermatically, so that the rectum is called upon to care for food only. Even fruit juices may be given by mouth, but proteid and fatty food, as well as appreciable quantities of sugars or other carbohydrates, are likely to excite an attempt at digestive activity and should be carefully avoided.

Except that nutrient enemata require no attention to the patient's taste—beyond ordinary care to avoid disgust—the same precautions should be observed to insure practical sterility and adequacy of the different kinds of food, as in nourishing in the normal manner. The basis of most injections is peptonized milk. If rectal alimentation is long continued, or if the patient has already been insufficiently nourished, meat extracts, and preferably those containing considerable amounts of hæmoglobin, or its iron-containing derivatives, should be added. Bovinine or fresh blood may be used. A diagnostic contraindication to blood-containing foods exists if there is a gastric or intestinal ulcer or other possible source of hemorrhage, requiring examinations of the stools to determine whether there has been oozing of blood. About 15 grams of sodium chlorid should be given daily, though not necessarily by the bowel. A deficit of carbohydrates may be made good by the use of glucose, which is obtainable—at candy factories, if not at drug stores and groceries—either in lumps, powder or a thick syrup of nearly 100 per cent strength. The following formula is suggested as conforming fairly well to the needs of the body:

R.	Proteid.	Fat.	Carbo-hydrate.
Peptonized milk. 400 c.c.	16	16	16
1 egg..................	5	8	..
Glucose ....30 Grams	..	..	30
	—	—	—
	21	24	46
Three injections daily...	63	72	138

Gruels may also be used, estimating the nutriment from the weight of the dry flour or meal, before mixing, if it is thought best to increase the amount of carbohydrate for it is rarely possible to administer more clear glucose without causing irritation and even the 90 grams daily may prove too much, on this account. The various prepared cereal-milk infant foods may also be substituted and, as mentioned, blood or meat extracts to counteract anemia. Unless salt is given by hypodermoclysis or by the stomach, 5 grams should be added to each enema.

Nutrition Through Fistulæ.—Mechanic obstacles to gastric nutrition are usually of longer duration than the tolerance of rectal alimentation. Thus, unless the patient's condition contraindicates operation or unless operation is obstinately refused, surgical relief should be afforded immediately, before the patient's strength has notably declined. From the dietetic standpoint, fistulæ are of two kinds, external and internal, the latter referring to anastomoses, to short-circuit some obstacle, such as a pyloric tumor, an intestinal stricture, etc. External fistulæ are practically limited to the stomach and upper portion of the jejunum, there being no physiologic advantage to compensate for the surgical obstacles to entering the duodenum, while it is obviously futile to introduce nutriment low down in the bowel, as life can rarely be maintained unless two-thirds of the small intestine is present or functionally available. Thus, a low fistula, has little dietetic advantage over rectal alimentation and certainly not sufficient to counterbalance the risk of surgical interference.

Regarding the choice between gastrostomy and gastro-enterostomy on the one hand and superior enterostomy on the other, the writer has elsewhere emphasized the fact that a stomach which is the seat of a malignant disease, in the broadest clinical sense, should be entirely short-circuited, both because the entrance of food and the attempt at digestion tend to accelerate the malignant process and because the latter introduces toxins which should be eliminated, so far as possible. Thus, gastrostomy should be limited to cases of purely mechanic obstruction in the esophagus or at the cardia, with a normal or nearly normal stomach while gastro-enterostomy should be limited to non-malignant pyloric obstruction or an obstruction in the duodenum or upper jejunum, including tubercular and cancerous disease which can be satisfactorily short-circuited. Otherwise, an intestinal fistula should be established. In one case, reported in International Clinics, an absolute cure of pyloric and cardial tumors was accomplished by the physiologic rest afforded by a jejunal fistula. Removal of the stomach was mechanically impossible and, even at the operation, the tumors were supposed to be malignant. Their subsequent disappearance showed that this could not have been the correct diagnosis. They may have been tubercular lymph nodes and, at any rate, the jejunal fistula was even more strongly indicated than was supposed for the patient was dying of inanition and what was undertaken as a palliative operation, to prolong life, proved radically successful. Granting that the correct diagnosis could be made in advance, life might have been saved by rectal alimentation, without operation, but this alternative is only theoretic, first, because it is practically impossible to make such a diagnosis, and, secondly, because of the improbability of introducing and maintaining sufficient nutrition, by the rectum.

When an anastomosis has been established, no special dietetic care is necessary, beyond avoidance of gross errors in introducing mechanically or chemically irritating food or that which is otherwise inadequate or injurious.

In the case of a properly indicated gastric fistula, it is advisable to have the patient masticate the food and spit it into the funnel connected to the stomach tube, thus insuring salivary digestion and reflex excitation of gastric secretion. An ingenious surgical device consists in a tube leading from the upper, normal portion of the esophagus, beneath the clothing, and introduced into the stomach through a fistula. The difficulty of preventing leakage from the upper wound and either lodgment of food in the upper esophagus or seepage into the lower esophagus, are practical objections to this operation.

When a jejunal fistula (nesteostomy) has been established, in preference to a gastro-enterostomy, for the reasons given above, the reflex excitation of gastric secretion by mastication, outweighs the benefit of securing salivary digestion, which is always of minor importance, so that the food should be artificially comminuted or administered in liquid or pultaceous form. In all cases in which the normal appetite and tastes of the patient are disregarded, the utmost care should be observed to maintain the proper amount and kind of nutriment, with reference to the three classes of organic food, water, sodium chlorid and iron, or hemoglobin. Other mineral matters are present in sufficient variety and amount in the raw materials commonly used. Surgeons frequently overlook this important indication and attempt to nourish on white of egg or other nearly pure proteid or even extractive matters.

Feeding Through the Esophageal Stomach

Tube—Gavage.—This method is most frequently employed in feeding insane patients who will not eat. Gavage is occasionally indicated for hysteric patients or those who are attempting to starve themselves to death but who are not insane in the ordinary sense. Aside from nervous cases, gavage is rarely indicated. Occasionally, however, after lavage of a catarrhal or irritable stomach, it is well to introduce peptonized milk or some cereal-milk food, etc., and, for some reason not understood, the stomach will often tolerate food thus introduced when food introduced in the natural way would be vomited, or larger amounts—as in the case with water alone —may be introduced through the tube, than would be swallowed.

In the case of esophageal diverticula or strictures of small caliber, but not absolutely impermeable, it is occasionally advisable to introduce a slender tube emerging through the nostril and held in place by some retentive device. Such a tube may be kept in place for a week or more at a time.

Hypodermic Nutrition.—Physiologic salt solution, containing about ½ per cent of sodium chlorid in pure, sterile water, is frequently introduced by hypodermoclysis and, though mainly regarded as a stimulant and eliminative, such solutions really are nutritive, in the inorganic sense. A still more accurate solution for the purpose of introducing inorganic food, is the formula of Schmidt, representing the inorganic composition of blood plasma:

Potassium sulphate.....	0.0281	per cent
Potassium chlorid......	0.0359	“ “
Sodium chlorid........	0.5546	“ “
Sodium phosphate......	0.0271	“ “
Sodium carbonate......	0.1532	“ “
Calcium phosphate.....	0.0298	“ “
Magnesium phosphate...	0.0218	“ “

Of such solutions, 1000-2000 c.c. may be injected in a day.

Hypodermic injections of oil have been used, but fat embolism has occasionally resulted, and, as sufficient fat, or at least, as much as can be introduced hypodermically, can be introduced by inunction, this danger should be regarded as an absolute contraindication.

The transfusion of defibrinated human blood is, essentially, a nutritive injection. The well known but vaguely understood bio-chemic reactions of sera of different species, contraindicate the use of blood of the lower animals and this fact, as well as the technical difficulties of the operation, render it impracticable except in emergencies.

However, the fact that substances capable of producing precipitation or hemolysis are mainly due to the cellular constituents of blood must be taken into account and we have an advocate of the safety of horse serum, in Salter (Guy's Hospital Reports, 1896) who has injected 100 to 120 c.c. without ill effects. But as the serum contains only 7½ to 8 per cent. of proteid, it is evident that no considerable part of the ration can be injected.

Raw egg albumin introduced into the circulation or even introduced into the stomach in considerable amounts is excreted unchanged by the kidneys, at least in part. The injection of peptones is followed by toxic, including febrile symptoms. Expressed meat juice is subject to the same theoretic objection as plasma of heterogenous origin, in addition to the difficulty of maintaining sterility. Vegetable albumin may perhaps be available for nutritive hypodermic injection, but, in general, there is no experience to guide us as to the hypodermic method of introducing proteid nourishment.

C. A. Ewald (Medical Record, October 18, 1900) states that, for subcutaneous feeding, neither albumin nor carbohydrate can be used, but that 100 to 150 c.c. of olive oil may be employed. Voit and other German experimenters have, however, injected as much as 25 grams of glucose without ill effects. Their experiments antedate the writer's independent clinical use of glucose, which has been applied to a number of emergent cases without either local or systemic evidence of harm being produced. The method is as follows: 100 grams of glucose or 100 c.c. of the commercial thick syrup which is nearly 100 per cent. in strength, is added to 1000 c.c.

of physiologic salt solution, and is sterilized by boiling. All apparatus is sterilized in the same way and the skin of the patient, in the usual manner. A canula is introduced beneath the skin and, by means of a hypodermic syringe, is filled with salt solution to avoid injection of air. The nutrient solution is introduced from a fountain syringe, care being taken that the rubber tube is filled to its tip, before slipping it over the canula. Two such injections may be made in twenty-four hours, thus introducing practically half of the carbohydrate ration.

CHAPTER XXIII.

DIET IN RESPIRATORY, CARDIAC, NERVOUS AND OTHER DISEASES.

RESPIRATORY APPARATUS.

Acute inflammations, in general, indicate an immediate reduction of diet and even absolute withholding of food for a day or two. Water should be freely given, in order to favor elimination. Indeed, abstinence from food and copious draughts of hot water may abort a cold. Asthenic inflammations, even of acute course, require an abundance of bland, easily digested and nutritious food, according to the methods already discussed as applying to fevers in general. Chronic conditions, whether tracheal, bronchial, broncho-pneumonic or actually tubercular, require the ordinary but carefully guarded diet of persons in health, with especial attention to the introduction of rather more than the standard amount of fats, either in the form of cream, butter, chocolate, fried pork, etc., or as cod liver oil and other medicinal fats, if the latter are well borne. Inunction can usually be employed so as to introduce at least 25 grams a day. While many authorities advocate overfeeding in pulmonary tuberculosis, this course should be pursued with caution and it should be remembered that the mere increase of weight has comparatively slight influence upon the general health. Overfeeding to the extent of overtaxing the digestive powers and producing flatulent dyspepsia, is distinctly harmful.

Constitutional asthma has already been considered by implication under the heading of diseases of nitrogenous suboxidation. It is occasionally found that some special article of food, usually sapid or odorous, acts as an exciting cause of asthmatic paroxysms.

Onions, garlic and other vegetables, whose active principles are eliminated in the breath, favor the blood supply of the lungs and even exert a slightly antiseptic action, but this favorable tendency may be more than counterbalanced by the local effect upon the digestive organs of a large mass of fermentable cellulose, containing little digestible material.

Ulcerative conditions of the pharynx and larynx often cause considerable dysphagia and demand either the use of bland, semi-liquid food, or in extreme cases, feeding under the action of a local anesthetic or through the tube.

CIRCULATORY APPARATUS.

The chief dietetic errors that may indirectly lead to cardiac and vascular disease are, insufficient nutrition, excessive ingestion of proteid and more particularly of nuclein and purin-containing food, excessive ingestion of calsium, especially after middle life, and insufficient use of water. Functional disturbances are predisposed to by the excessive use of xanthin-containing beverages, especially tea, coffee and strong chocolate, and tobacco, in any form, but especially chewed. Alcohol tends to disturb the function of the heart and vaso-motor system and is a potent cause, directly or indirectly, of vascular degenerations. After middle life, alcohol may be used to relax arterial spasm and thus diminish the obstacle to the heart's action, with relative impunity. Hard water should be carefully avoided, and, as it is difficult to exclude from the diet vegetables rich in lime, the use of distilled water may be indicated, but the writer is of the opinion that sodium chlorid should be of 5 to 1000. When proportion added in the senile or distinctly pathologic sclerosis and, *a fortiori*, calcification of blood vessels exists, vasocontraction by tea and coffee, and indirectly from the stimulant action of alcohol, is to be avoided. So, too, is the mechanic embarrassment due to overfilling of the stomach with food, liquids, or gases, whether from effervescing drinks, or fermentation of ingesta.

In the presence of cardiac valvular disease, well compensated, no special attention to diet is necessary, beyond avoiding positive indiscretion. Whenever compensation fails, the food should be bland, easily digested, without tendency to produce fermentation and so measured, by clinical methods, as neither to exceed nor to fall below the standard of a person at light exercise or closely confined to the house or bed, respectively.

In all hemorrhagic diseases, gelatin is indicated, and may be given in palatable form, by the mouth. (See discussion under Semi-medicinal Dietetics.)

Tufnel's treatment of aneurism consists in the following regime: Breakfast and supper, 2 ounces of bread with a little butter and 2 ounces of milk; dinner, 2 to 3 ounces of meat, without salt, and 4 ounces of milk, for part of which claret may be substituted. Such a diet obviously tends to blood concentration, and diminution of blood pressure, both on this account and by weakening and slowing the heart. On the other hand, it neither aids the general nor vascular nutrition, nor does it tend to coagulation except on account of the condensation and slow current of the blood. The rational diet for aneurism is rich in gelatin, low in extractives, water and salts and rather, but not excessively, below the normal standard in the various organic nutriments.

DIET IN SKIN DISEASES.

The accepted classification of skin diseases is according to external appearances rather than to underlying causes, so that, under the same term, may be included various metabolic abnormalities, or purely local irritations or local or general parasitic diseases, or nervous reflexes. Thus, the anatomic diagnosis is not a guide to dietetic management, but each case should be treated on general principles, as applied to the underlying cause. The various angio-neuroses of the skin, notably urticaria, and even some forms of dermatitis or eczema, may be directly due to diet. The most extreme illustration is found in gangrene due to grain contaminated with ergot or ustilago. Erythema, urticaria, or dermatitis, according to the degree of irritation, may be due to idiosyncratic articles of diet, including shell fish, strawberries, pork, sausage, preserved meats, cheese, mushrooms, etc. In some instances, the irritation seems to be due entirely to an inexplicable idiosyncrasy. In others, a more or less demonstrable formation of toxins, as by partial decomposition by saprophytes, is the true explanation. Alcohol and, according to some authorities, even tea, coffee and chocolate, may cause rosacea. Once developed, dietetic management can accomplish little.

Acne, though directly an infection from saprophytes of the skin, is favored by an accumulation in the sebaceous glands, and, hence, by excess of greasy food. For some unexplained reason, it also follows rather closely upon overindulgence in pancakes. It is doubtful if buckwheat has any distinct causal relation to acne, but probably any food which digests with some difficulty, and which is habitually eaten with an abundance of gravy or butter and sugar or syrup, tends to cause acne.

Furunculosis, especially in diabetes, is especially liable to occur if carbohydrates are freely eaten, though it is questionable whether they have any direct bearing on the skin lesion, or whether they act merely by aggravating the constitutional state.

Various dry, scaly conditions of the skin and scalp demand an increase in the available fat, which should, however, be administered in a readily assimilable form, as in butter and cream. Fried meats, doughnuts, etc., are always liable to be tainted with rancid, fatty acids.

Constitutional eczema, as opposed to the forms due to local irritation of various kinds, and especially that in which heredity is manifest, should receive the dietetic management of gout, remembering that it is not so much proteid as purin bodies, including extractives which are present in excess in the viscera, that are harmful. Indeed, in "poor man's" gout, and certain forms of infantile eczema, with obvious impoverishment of the constitution, a liberal diet should be instituted and the milk should be investigated, with reference to proteids, as well as fats.

Pruritus, without obvious local cause, and occurring irregularly throughout the body, is also a manifestation of nitrogeneous suboxidation or of faulty metabolism in some way not understood at present. At times the itching is so sharp and local as to suggest the actual precipitation of urates in a nerve terminal, analogous to what occurs in a joint, but on a small scale. Such cases are usually accompanied by hepatic sclerosis and are to be dieted according to the principles already discussed.

The marked pruritus due to deposits of biliary pigment in jaundice is also to be treated constitutionally, with reference to free elimination.

Skin diseases not discussed in detail, as well as the conditions commonly assigned to purely local specialties, as the eye and ear, throat and nose, etc., are to be dieted according to general indications.

DIET IN DISEASES OF THE BLOOD AND BLOOD-MAKING ORGANS.

Very few of the essential diseases of the blood cells, or of the organs supposed to be concerned in hematopoiesis are amenable to any form of treatment, yet the endeavor should be made to support the general nutrition and to provide an abundance of iron and salts for the blood. Hodgkin's disease, clinically determined, is often a tuberculosis of the spleen and lymphatic glands, although most authorities insist on distinguishing, pathologically, if not clinically, an essential malignant lymphoma. Leucocythemia is, with equal justice, to be regarded as a neoplasm, of unknown cause, as is the case with most neoplasms involving numeric hypertrophy of the cells of fixed tissues.

Leucocytosis is to be regarded as essentially a conservative process and as, at most, a symptom of inflammation in accordance with which the diet is to be regulated. Leucopenia is the expression, if not the underlying cause of many states of constitutional weakness and demands supporting treatment of the most vigorous kind. Eosinophilia of mild degree is symptomatic of Addison's disease, mental hebetude, etc., and is frequent among the insane. The dietetic indications are on general lines only. A marked eosinophilia, from 10 to 60 per cent., is quite characteristic of certain intestinal or other animal parasites and should call attention to the possibility of continued infection from food. Therapeutic dietetics is along general lines. Relative abnormalities in the different leucocytes are little understood, but, as a rule, they indicate some disturbance of nutrition and demand ample and careful attention to diet.

The red blood corpuscles, like elastic tissue, seem not to be liable to neoplastic excess. Alterations in the saline and watery constituents of the blood are little understood and they seem not to exist except transiently, without obvious anemia, that is, failure of the red cells or of their hemoglobin. Failure of hemoglobin alone is not found as a clinical disease and although, theoretically, we may classify anemias according as the ratio of hemoglobin to cells is 1, greater than 1 or less than 1, these distinctions are not very clearly established clinically and they rest, even scientifically, mainly upon estimations of hemoglobin by color, or specific gravity of the blood, as a whole, which are far from exact. The graver forms of anemia may be marked by a color index of hemoglobin-cellular ratio which is greater than 1, while in chlorosis, the ratio is usually less than 1. In these conditions, there exists a special indication for increasing cell metabolism and hemoglobin assimilation, respectively, but we must confess our ignorance of definite means of meeting these indications.

DIET IN ANEMIA.

In the ordinary, simple anemias, the color index is 1 or slightly less than 1. Practically speaking, all forms of anemia demand the maintenance of good general nutrition by a full and easily assimilated ration, with special attention to the assimilation of iron. In many cases, the urine and, therefore, presumably, the blood, is lacking in alkalinity. Direct investigation of the blood with regard to this point is not clinically impossible, yet it is difficult, and is usually omitted. Many writings on this subject are misleading, giving the impression that the blood becomes positively acid, which is probably never the case. In refractory cases, it is advisable to have the saline and waste matters of the blood estimated by a chemist and to institute a diet according to the findings. At least, by Purdy's centrifugal method, the salines of the urine can be easily, though approximately, estimated, and the corresponding dietetic compensation may be made.

All anemias may be considered as toxemic, the poison arising in the alimentary canal by fermentation and putrefaction in the system during an infection, or as the direct result of inhaling or ingesting some well-known poison. The last may be present in food, water or medicine. Sulphur, whether derived from water or present in organic combination in food, tends to combine with all simple forms of iron and to prevent their assimilation by the body. The sulphur of proteids, as that contained in eggs, does not directly destroy iron, so far as the purposes of the body are concerned, but it does have this action after decomposition by the colon bacillus. Any marked degree of sulphurous decomposition in the intestine is readily determined clinically, and may be partially controlled by the administration of internal antiseptics. Marked sulphurous decomposition does not occur in the stomach, except in cases of stagnation, often incident to gastric cancer.

From the practical standpoint, most anemias, or, indeed, nearly all blood diseases, may be grouped together. While from the standpoint of etiology, pathology or prognosis, we may make distinctions, the common therapeutic indications are: to avoid the presence of hemolytic toxins, to stimulate hematopoiesis and to secure an abundant assimilation of iron. The first indication applies to dietetics in the elimination of gross toxic substances from the ingesta and the selection of foods in accordance with the general requirements of healthy nutrition, with special attention to the avoidance of fermentative changes in the alimentary canal and of irritation or overtaxing of the liver and kidneys, as is considered in the chapters dealing with these organs. It is extremely doubtful whether any dietetic or other therapeutic case can directly influence hematopoiesis. It is possible that some form of splenic extract may be developed which shall stimulate the formation of red cells and it is already claimed that red bone-marrow has such a function, in addition to the mere supplying of readily assimilable iron. It is with the third indication that the dietetic management of anemia is chiefly concerned.

IRON AS A FACTOR IN ANEMIA.

Three questions are of the utmost importance in the intelligent management of anemia: Is sufficient iron digested? If not, is the fault mainly with the digestion, absorption or assimilation of iron? Or, is the anemia due to an essential increase of elimination? It must also be borne in mind that the practical proof of the efficiency or inefficiency of any method of treatment depends upon blood examinations and that the general complexion and sensations of the patient can not be relied upon. Pallor may often be due to relative lack of pigment while the blood is normal while, conversely, a dark or even pink skin does not necessarily indicate the normal condition of the blood. By means of the hematocrit and the Tallquist hemoglobinometer, sufficiently accurate clinical examinations of the blood may readily be made.

With the exception of haemoglobin, iron does not occur in any of the normal, active proximate principles of the body, though it is present in various intermediate organic combinations, during the process of absorption, assimilation and excretion. Bunge states that the amount of iron in the standard adult, is about 3.3 grams. About 80 per cent. of the total is found in the red cells of the blood, most of the remaining 20 per cent. being in the haemoglobin of muscle plasma. Other authorities place the muscle haemoglobin higher and Moss's table (See Chapter I) implies the presence of about 7 grams of iron in the body. From .5—1.5 milligrams of iron are daily eliminated in the urine (Hamburger) and a much larger amount in the faeces, most of the latter being exogenous iron. The nursing infant, which already has an abundant surplus of iron in the liver, receives about 3.3 milligrams daily, a very important point from the mother's standpoint, as the elimination in the milk is 2—7 times the normal urinary elimination. Quincke and v. Noorden state the daily demand of iron at ten centigrams. Chiefly on account of Bunge's assertion, it has been quite commonly held that inorganic iron is not absorbed but that it may serve a useful purpose by combining with sulphur in the intestine and thus allowing organic compounds in food to be utilized. This belief, though true in the quantitative sense, is not correct, as may be shown by staining the mucous membrane of the duodenum with ammonium sulphid before and after the administration of inorganic, medicinal forms of iron, to animals. By microscopic examination of the stained section of intestine, it can be shown that the absorption is largely due to the conveyance of minute particles of iron by leucocytes. That this iron is actually assimilated, at least in part, is demonstrated partially by clinical experience and blood examinations, more conclusively by similar observations on lower animals placed on an iron-free diet, except for inorganic iron. Lazarus (Die Anaemie by Ehrlich) goes so far as to claim that the superiority of organic forms of iron rests solely on their unirritating properties and that as a food, inorganic iron is superior. Ordinarily, iron is first converted into the chlorid by the stomach and the portion which resists precipitation as the sulphid in the intestine, undergoes subsequent organic combination, the details of which are vaguely understood. Dr. John C. Hemmeter, however (Phila. Med. Jour., Jan. 20, 1900), reports a case of gastric atrophy with, of course, total lack of hydrochloric acid secretion, in which the absorption of iron given in the form of carbonate, was demonstrated at the necropsy.

From the dietetic standpoint, organic forms of iron, as contained in meat and certain vegetables, are preferable to inorganic or proprietary organic forms. It is stated that, as a rule, vegetable products characterized by a green, brown or red tint, are rich in iron. (See also, analytic table.) The assimilation of iron is also favored by the avoidance of sulphur-containing proteids as well as by maintaining a fairly aseptic condition of the intestine. The writer believes that the clinically demonstrated value of arsenic in anaemia is largely due to its antiseptic action.

The number of milligrams of organic iron contained in 100 grams of the following food substances in a dry state:

(Bunge.)

White of hen's egg	Trace
Rice	1.0-2.0
Pearl barley	1.4-1.5
Wheat flour (sifted)	1.6
Cow's milk	2.3
Human milk	2.3-3.1
Figs	3.7
Raspberries	3.9
Hazel nuts (kernel only)	4.3
Cabbage (inside yellow leaves)	4.5
Rye	4.9
Almonds (peeled)	4.9
Wheat	5.5
Bilberries	4.7
Potatoes	6.4
Peas	6.2-6.6
Cherries (black, without stones)	7.2
Beans (white)	8.3
Carrots	8.6
Wheat-bran	8.8
Strawberries	8.6-9.3
Linseed	9.5
Almonds (brown skins)	9.5
Cherries (red, without stones)	10
Hazel nuts (brown skins)	13
Apples	13
Dandelion leaves	14
Cabbage (outer green leaves)	17
Beef	17
Asparagus	20
Yolk of egg	10-24
Spinach	33-39

The amount of various foodstuffs, in the form in which ordinarily taken, required to furnish ten milligrams, or 1/6 grain, of iron, the amount required by an adult per day:

(Bunge—Adapted by J. H. Kellogg.)

Rice	2.3 lbs.
Pearl barley	1.7 lbs.
Wheat flour (sifted)	1.6 lbs.
Cow's milk	1 gal.
Human milk	6.5 pts.
Figs	2.2 lbs.
Raspberries	3.4 lbs.
Hazel nuts (kernel only)	9 oz.
Barley	11.5 oz.
Cabbage (inside yellow leaves)	5.2 lbs.
Rye	5.4 oz.
Almonds (peeled)	7.5 oz.
Wheat	7.8 oz.
Potatoes	1.5 lbs.
Cherries (black, without stones)	1.6 lbs.
Beans (white)	5.2 oz.
Carrots	3 lbs.
Strawberries	2.2 oz.
Almonds (brown skins)	4.8 oz.
Cherries (red, without stones)	1.1 lbs.
Hazel nuts (brown skins)	2.3 oz.
Apples	1.2 lbs.
Cabbage (outer green leaves)	1.2 lbs.
Beef	9 oz.
Asparagus	2 lbs.
Yolk of egg	4 oz.
Spinach	11 oz.

The elimination of iron is normally very slight, so that the ingestion of ten centigrams a day is adequate. This amount is contained in about 1,000 grams of fresh muscle, free from blood, and, as ordinarily cooked, the proportion is slightly higher. Generally speaking, sufficient iron is introduced in any standard, varied diet. It is liable to be deficient in a strict vegetarian diet, and is almost always so in a diet of milk and prepared cereals.

Iron is normally digested from the inorganic to the organic, assimilable state, first by the action of hydrochloric acid in the stomach and then by combination with proteids, either in the stomach or duodenum. The first step may be omitted, as is shown by the presence of sufficient iron in the blood of patients having a chronic failure of hydrochloric acid, although this condition is very liable to induce failure of hemoglobin. The absorption of iron occurs mainly by incision in leucocytes, which convey it into the lacteals of the duodenum—as can readily be demonstrated by straining with ammonium sulphid, after administering any form of inorganic iron to an animal. The actual assimilation of iron is not well understood. It is eliminated mainly through the wall of the large intestine, in the bile, urine and hair.

We have no means directly of influencing the assimilation or elimination of iron. Its digestion is aided by maintaining a proper hydrochloric acidity in the stomach and by avoiding fermentation, which tends to cause gastro-duodenal catarrh, or to hurry the food mass through the duodenum. Precipitation of iron by sulphur-compounds is avoided by restricting internal putrefaction and the ingestion of sulphur-proteids in excess. Perhaps the clinical value of arsenic in conditions of lack of iron is due mainly to its antiseptic action in the stomach and bowel. Granted that sufficient iron is ingested, whether in organic or inorganic form, we can secure its absorption and assimilation only by these precautions against its waste and by attention to the general health. A body which lacks sufficient organic nutriment cannot be expected to maintain a normal metabolism of iron. It has been taught for some years that inorganic iron cannot be assimilated and that its only therapeutic value consists in furnishing a chemic antidote to sulphur-compounds and in thus allowing the absorption of organic iron. While inorganic iron certainly has this action, animal experiments positively demonstrate that inorganic iron is not only absorbed but assimilated, the blood having been maintained at a normal standard on a diet absolutely free from organic iron.

Experimental and clinical experience, on the whole, supports the dictum that it is useless to administer inorganic iron to a patient already ingesting sufficient organic iron in the food, unless with the idea of affording a precipitant for sulphur compounds, and that many forms of inorganic iron are irritating, both to the alimentary canal and to the liver. Artificial substitutes for hemoglobin of meat and the normal organic compounds of iron in vegetables are inferior to unirritating medicinal preparations of iron, such as the carbonate and vegetable-acid salts. Excessive sulphurous decomposition is better combated by antiseptics and the avoidance of sulphur-containing ingesta, than by crowding the ingestion of iron. Excessive elimination of iron is not susceptible of direct treatment, but is lessened by attention to the general nutrition and may be partially compensated by the ingestion of an increased amount of iron. All things considered, the writer believes that the most practical form of iron is found in meat and blood. The latter may be obtained fresh, at slaughter houses, and bottled with the addition of a small quantity of magnesium or sodium sulphate, to prevent coagulation. It may be kept on ice, almost indefinitely, without any antiseptic and it is not distasteful except psychically. If the patient objects seriously to the use of fresh blood, or cannot be kept in ignorance of the nature of his "red tonic," bovinine or some other preserved blood may be employed.

In combating anemia, it must be remembered that trional and its congeners, as well as most heavy metals, tend toward hemolysis. Carbon monoxid from a coal stove or leaky gas pipe, or carbon monoxid or cyanogen compounds from smoking tobacco, arsenic from carpets and wall paper must also be considered as possible causes.

DIET IN NERVOUS DISEASES.

In most organic nervous diseases the diet is to be regulated on general principles. Lesions due to intracentral hemorrhage or embolism require almost identical care to avoid elevation of blood pressure, as both lesions occur in patients with fibroid and calcified vessels. Increased intracranial pressure from whatever cause, also contraindicates superalimentation, free use of tea, coffee, alcohol, etc., or even too liberal use of water.

Peripheral nervous conditions, whether neuritic, neuralgic, herpetic or otherwise, indicate a need of proper nutrition and an avoidance of food liable to lead to intraalimentary fermentation and putrefaction or to metabolic abnormalities after absorption. It is a trite saying that neuralgia is the cry of a starved nerve for food and it is worthy of consideration whether many cases of so-called *neuralgia* are not genuine cases of *neuritis* or of nerve degeneration analogous to that of the tracts of the spinal cord.

It may be pointed out, in this connection, that there are several diseases, characterized largely by nervous phenomena, due to dietetic errors, and standing midway between intoxications and infections. These are ergotism, ustilagism, lathyrism, pellagra, and, probably beri beri. The first three are characterized by vaso-constriction, even to such a degree as to end in gangrene. The first two are definitely connected with the intoxication of fungi which are parasitic to rye and corn, respectively. Lathyrism is due to adulteration of meals with the chick-pea or vetch but it is not known whether the vaso-constricting agent is derived from the vetch itself or from a fungus parasitic to it. Pellagra is due to saprophytes developing in corn and is readily prevented by excluding fermented corn or even, it is said, by the free use of salt in the corn meal. Beri beri has been studied mainly from the standpoint of an infection and has even been claimed to be contagious. If contagious, it must be separated from this group of diseases but the evidence of its infectiousness is not strong and practically all authorities claim or admit that it depends largely upon a too nearly exclusive diet of rice. Some investigations have even connected it with certain grades of rice while other clinical observations have seemed to incriminate fish. At any rate, a change of diet, to a wholesome and varied regimen, is of the utmost value in the treatment. As beri beri is a polyneuritis, the toxic theory of pathogenesis is in harmony with that of other forms of polyneuritis. Arsenic, other heavy metalloids, and metals, alcohol, the toxins of certain infections and those arising from faulty metabolism, are also etiologic factors in the production of polyneuritis. The importance of dietetic management is obvious and it should be along the lines discussed under the intestine, liver, and nitrogenous metabolism, with due care to maintain full nutrition.

As the classification of nervous diseases is largely clinical, many conditions commonly so considered belong under other headings, and, at any rate, the dietetic regimen is to be planned according to general principles. Chorea, for instance, may be rheumatic, though whether in the sense of an infection or a metabolic disturbance, is not clear. Aside from the general indication to maintain full nutrition, and not to overtax the emunctories, special attention must often be given to the state of the heart. Epilepsy depends upon intestinal fermentation and putrefaction and faulty metabolism, at least as exciting causes of the acute attacks and the same conditions apply as contributing causes to many cases of insanity. In all nervous conditions, it is important to maintain nutrition, as well as avoid toxemias, and it may be necessary, not only to direct but to secure personal supervision of the feeding of the patient, or even to resort to gavage.

While hysteria depends largely upon a lack of nervous stamina and self-control, it is often purely a reflex from organic disease or a state of intoxication with renal or hepatic waste. Thus, the correct, exact diagnosis, not only emphasizes the need of regulating the amount of food ingested, but calls attention to the qualitative dietetic conditions to be met. Neurasthenia is better appreciated if we translate the term into *nervous exhaustion.* The indication is plain to afford absolute mental rest and full nutrition, without overtaxing the digestive organs. S. Weir Mitchell's rest cure fulfills these indications by placing the patient in bed, allowing him to see no one but his nurse, instituting an abundant diet of which milk is the principal constituent and relying upon massage to prevent constipation, atrophy of voluntary muscles and accumulation of waste products. It is questionable whether the same indications cannot be better met by camp life, with provision against actual hardship and too coarse food.

DIETETICS IN OBSTETRICS.

During a normal pregnancy, the diet should be liberal, varied, of a nature to obviate constipation or diarrhea, but the appetite should not be spoiled by too arbitrary interference with customs of eating, and even cravings for peculiar articles should be gratified to a reasonable degree.

Beyond occasional and trifling morning nausea and vomiting during the early months, vomiting and other digestive disorders should not be considered as diagnostic symptoms of pregnancy, but as diseases to be investigated and treated precisely as in the nonpregnant state, except that the stomach tube, rectal douche and certain drugs should be used with caution. The stomach tube, however, will do much less harm than marked nausea and vomiting.

The occurrence of albuminuria or other indication of nephritis, as well as cholemic symptoms or marked disturbance of the thyroid function, to some degree threaten eclampsia and should have dietetic treatment on the lines already considered under the respective headings. In uremia, an absolute milk or milk and cereal diet is usually indicated, but care should be taken not to allow too marked anemia to develop.

Lactation is favored by an abundance of easily digested food. There is no genuine galactogogue, although beer and other alcoholics as well as a liquid diet tend to a free secretion of milk. Cow's milk affords a supply of materials needed by the mammary glands. The breast milk should be tested occasionally, especially if the baby does not thrive, and any deficiency of proteid, fat or lactose should be met by a corresponding increase in the maternal ingestion. During lactation, practically all active principles, toxic minerals, etc., should be omitted unless the therapeutic indications are most urgent. Even saline and vegetable cathartics administered to the mother are apt to affect the child similarly, but, fortunately, the same indication often exists for both. The mother may also be sacrificed for the sake of medicating the child through the milk.

The various complications in pregnancy, the puerperium and lactation are to be treated on the same general principles that apply to the dietetics of nonobstetric conditions, removing the child from the breast if there is good reason to fear vitiation of the quality of the milk.

DIETETICS IN RELATION TO SURGERY.

Except in rare instances, general anesthesia should not be induced on a full stomach nor without having anticipated the daily evacuation of the bowels. Thus, all nonemergent operations should be performed in the morning, so that the patient loses only his breakfast, and he may even have a cupful of clear tea or coffee two or three hours before the operation. In emergent cases, the stomach should be emptied, if possible, by irritation of the fauces or the use of a mild local emetic such as mustard. The tube can rarely be satisfactorily used to remove food remnants thoroughly. If the patient is already unconscious or if some other contraindication exists, assistants should be provided to turn the patient quickly, in case of vomiting; a gag should always be at hand, and it may be well to transfix the tongue with a ligature in advance of operation, and instruments for immediate tracheotomy should be in readiness.

After operation, the principal dangers from vomiting are hemorrhage from rise of vascular tension, separation of an abdominal or vaginal wound, prolapse of viscera through the wound, general depression, amounting even to syncope, and asphyxiation, especially to be dreaded in heavy and extremely weak patients, who cannot be quickly turned by a single nurse.

Operations upon the tongue, larynx, epiglottis, pharynx and esophagus, theoretically indicate rectal feeding until complete union has occurred. But, as infection cannot be wholly prevented, bland, liquid food, of medium temperature, may be given if the patient prefers to swallow, and hydrogen peroxid sprays should then be used after each feeding. Dr. Julius Pohlman, of Buffalo, some years ago, demonstrated that the removal of the epiglottis does not interfere materially with deglutition, though some caution should be exercised till the patient has become accustomed to the deprivation. If an extensive removal of the palatal arch has been practiced, gavage may be necessary. When the esophagus is involved, or even after the opening of an abscess deep in the pharynx, great care is necessary to avoid infection by food of cellular tissue, or the establishment of a diverticulum. Feeding through the tube or rectal alimentation should, therefore, be practiced, according to special indications, until firm union has been secured.

The management of fistulæ has already been discussed. In general, it should be recognized that the dietetics of important surgical cases should be under the direction of a medical attendant. The surgeon who attempts to control such purely internal problems is as much to be censured as the physician who should essay a capital operation without special skill and experience along surgical lines.

Post-operative dietetics requires no special discussion, provided that the gastro-enteric canal, the abdominal wall, including the diaphragm and pelvic floor, and the mouth, throat and esophagus, have not been involved. When the abdominal wall is involved in the wound of operation, semiliquid nutriment, preferably predigested may be allowed after 24—48 hours, but in all cases in which gastro-enteric complications are liable to ensue, food may usually be entirely omitted and only salt solution may be given by rectum or through the skin. Food which is at all likely to cause nausea, fermentation or excessive peristalsis, should not be allowed till healing is well advanced.

Operative cases involving section of the stomach or intestine, within the abdominal cavity, should be nourished by the rectum for at least a week, or longer, if there is any doubt of the restoration of continuity. When, however, a gastric or intestinal fistula has been made, so that the wound is under direct observation, and subject to no strain by the introduction of a soft tube, feeding may be begun after twenty-four hours, and, if inanition is threatened, even immediately. Operations on the rectum, on the other hand, require food that leaves practically no residue, for a few days, such as predigested milk, eggs, sugar, corn starch, meat extracts, etc.

Operations on the biliary tract require especial care, on account of the danger of nausea, and, if possible, food and water should be given by the rectum alone for several days. Jaboulay, Tixier and von Chappet report two cases of biliary fistula with troublesome leakage, occurring intermittently and at an interval of 5½ hours after a meal. By giving a late evening meal, so as to divert the bile into the intestine, the leakage was prevented and the fistula eventually healed.

APPENDIX.

CHEMICAL SYMBOLS AND FORMULAE.

H.—Hydrogen.

C.—Carbon.

O.—Oxygen.

N.—Nitrogen.

S.—Sulphur.

P.—Phosphorus.

Fe.—Iron (Ferrum).

Ca.—Calcium. (Calcium oxid is quick lime, calcium hydroxid slaked lime and calcium itself is commonly called lime.)

Mg.—Magnesium.

Na.—Sodium (Natrium). (Sodium hydroxid is caustic soda, sodium carbonate washing soda, sodium bicarbonate cooking soda.)

K.—Potassium (Kalium). (Potassium hydroxid is caustic potash.)

Cl.—Chlorin.

Si.—Silicon.

I.—Iodin.

F.—Fluorin.

$H\ Cl$.—Hydrochloric acid.

H_2O.—Water.

CO.—Carbon monoxid.

CO_2.—Carbon dioxid (carbon dioxid formerly called carbonic acid gas).

$Ca_3\ (PO_4)_2$.—Calcium phosphate.

$Mg_3\ (PO_4)_2$.—Magnesium phosphate.

$Na_3\ (PO_4)$.—Alkaline or tribasic sodium phosphate.

$Na_2\ H\ PO_4$.—Neutral or disodic phosphate.
$Na\ H_2\ PO_4$.—Acid or monobasic sodium phosphate.
$Na\ Cl$.—Sodium chlorid or common salt.
$Ca\ CO_3$.—Calcium carbonate.
$Mg\ CO_3$.—Magnesium carbonate.
$Na_2\ CO_3$.—Sodium carbonate.
$NaH\ CO_3$.—Sodium bicarbonate.
HCl.—Hydrochloric acid.
$Ca_3(PO_4)_2$.—Calcium phosphate.
$Mg_3(PO_4)_2$.—Magnesium phosphate.
$Na_3(PO_4)$.—Alkaline or tribasic sodium phos-
Na_2HPO_4.—Neutral or disodic phosphate.
NaH_2PO_4.—Acid or monobasic sodium phos-
$NaCl$.—Sodium chlorid or common salt.
$CaCO_3$.—Calcium carbonate.
$MgCO_3$.—Magnesium carbonate.
Na_2CO_3.—Sodium carbonate.
$NaHCO_3$.—Sodium bicarbonate.

METRIC UNITS.

While it is advisable, in any scientific study, to form the habit of thinking in decimal units, the following table of approximate relations is given to allow those unfamiliar with the metric system to form a definite conception of the magnitudes expressed in grams, cubic centimeters, etc. It should be understood that the equations are merely approximate and cannot be used for the accurate translation of values.

METRIC WEIGHT EQUIVALENTS.

1 milligram=1/1000 of a gram=1/64 of a grain.

1 centigram=1/100 of a gram=1/6 of a grain (or minim)=1/3 of a drop of water.

1 decigram=1/10 of a gram=1½ grains (or minims).

[The decigram, like the dime, is not commonly used but is expressed as ten centigrams.]

1 gram=15.4 grains.

1 dekagram=10 grams.

1 hektogram=100 grams.

[The dekagram and hektogram units, like the eagle in our currency, are not in common use; quantities up to a kilogram are read in grams.]

1 kilogram (commonly abbreviated and pronounced kilo)=1000 grams=2.2 pounds.

1 tonneau or metric ton=1,000,000 grams=intermediate between short and long English ton.

The gram is defined as the weight of a cubic centimeter of pure water at its point of greatest density, in vacuo. For practical purposes, temperature and atmospheric pressure may be disregarded and the gram and cubic centimeter may be considered identical for all liquids of about the same density as water. The same correspondence exists for the milligram and cubic millimeter.

METRIC LINEAR EQUIVALENTS.

For practical, scientific purposes, only five linear metric units are in use:

1 micron or micro-millimeter=1/1000 of a millimeter=1/25,000 of an inch.

[This unit is used in measuring microscopic objects and is about 1/7 of the diameter of an average human red blood corpuscle.]

1 millimeter=1/1000 of a meter=1/25 of an inch.
1 centimeter=1/100 of a meter=2/5 of an inch.
1 meter=about 40 inches.
1 kilometer=1000 meters=5/8 of a mile.

METRIC SURFACE EQUIVALENTS.

While a table of units of surface exists in theory, for practical scientific purposes, areas are expressed in squares of the various linear units.

METRIC VOLUME EQUIVALENTS.

The unit of volume is the Liter, or cubic decimeter, equivalent to 1000 cubic centimeters.

The Kiloliter, or liquid ton, is a cubic meter; a Kiloliter of pure water at its point of greatest density, in vacuo, weighs 1 metric ton or 1000 kilograms.

For practical scientific purposes, the theoretic fractional and multiple units indicated by the prefixes milli-, centi-, deci-, deka-, hecto-, kilo-, are not employed but volume is expressed in cubic millimeters, centimeters, and meters. Even the term Liter is not always used but is expressed as 1000 cubic centimeters, commonly abbreviated and pronounced c.c. As a matter of convenience, the equations between English and metric units of volume, are given in reverse order to those of weight.

1 drop=0.03 of a c.c.
1 minim=0.06 of a c.c.
1 fluid drachm=3.75 c.c.

[An old teaspoon contains about 4 c.c., a new one about 5 c.c., a coffeespoon about 1 c.c., a dessertspoon about 10 c.c., a tablespoon about 15 c.c.]

1 fluid ounce (apothecary's)=30 c.c.

[While the correspondence between metric measures of volume and weight, expressed in terms of water, is mathematically exact, a similar correspondence between the various English measures is only approximate. For example, the apothecary's fluid ounce equals 29.57 c.c., while the same ounce by weight equals 31.10 grams. The ounce avoirdupois equals only 28.35 grams.]

1 pint=475 c.c. (more exactly 473.11 c.c.)

[A pound, apothecary's measure, equals 373.23 grams. 16 ounces, apothecary's measure, equals 497.60 grams; a pound avoirdupois equals 453.60 grams.]

1 quart=946 c.c.—considerably less than a liter.
1 gallon=3,785 c.c.

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